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Mariners Weather Log

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Cover: Surprise visitor to North Carolina's Outer Banks at Rodanthe was the former Navy attack cargo transport BETELGEUSE. The vessel was blown ashore during a storm on January 17 while under tow to a Texas scrapyard. Bob Grieser Photo.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1980.

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Mariners Weather Log

EASTERN NORTH PACIFIC TROPICAL CYCLONES, 1975

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Tropical cyclone activity over the Eastern North Pacific in 1975 began June 2 and continued through November 7. It was a nearly normal season with 16 named storms and 4 tropical depressions. Of the named storms, eight developed to hurricane intensity. Table 1 shows the monthly distribution of the cyclone activity.

Advisories were issued on 87 days of the season--243 marine and military and 65 aviation advisories for tropical storms and hurricanes and 130 bulletins for tropical depressions. The distribution of cyclone activity was quite even, with only 4 days with three cyclones in progress at the same time and 19 days with two cyclones. When cyclones were in progress, bulletins or advisories were issued four times daily for each, at 6-hr intervals, 3 hr after synoptic chart times of 0000, 0600, 1200, and 1800. Amendments were issued five times during the season for changes in intensity of storms.

A comparison with cyclone activity in the recent past is shown in tables 2 and 3. The 1966-1975 period probably includes all tropical cyclone activity in the area because of the excellent satellite picture coverage during that time. Prior to 1966, cyclone occurrence was probably undetected due to the sparsity of data.

Two Air Force reconnaissance flights were accomplished--one into Agatha on June 5 and one into Olivia on October 24.

Satellite imagery supplied most of the cyclone fix and intensity data for the bulletins and advisories. Pictures at 30-min intervals from SMS-2 (Synchronous Meteorological Satellite) with full disk resolution of 4 mi and sector resolution of 2 mi gave excellent details. Intensity was calculated using the Dvorak method (Mariners Weather Log, Vol. 19, No. 4). The stability of the satellite over the Equator and good land marks make gridding of pictures accurate to within a few miles over the primary cyclone area. This resulted in accurate placement when typical features were visible. When storm development was poor, greater accuracy was available from the visible spectrum pictures than from the infrared. Greatest inaccuracies in intensity and location were experienced using infrared pictures when the cirrus shield over the cyclone was displaced from the surface circulation. This situation affected position accuracy enough to require relocation of storms eight times during the season, two of which were successive positions of Olivia when she was recurving on October 23. A cyclone was normally relocated when new data indicated the error in position was greater than the accuracy

Table 1.--Monthly distribution of Eastern Pacific tropical cyclones, 1975.*

	May	June	July	Aug.	Sep.	Oct.	Nov.	Total
Tropical storms	0	1	2	2	2	0	1	8
Hurricanes	0	1	2	3	1	1	0	8
Total	0	2	4	5	3	1	1	16

*Cyclone ascribed to the month in which it began.

Table 2.--Frequency of Eastern Pacific tropical storms and hurricanes combined by months and years.*

Year	May	June	July	Aug.	Sep.	Oct.	Nov.	Total
1966	0	1	0	4	6	2	0	13
1967	0	3	4	4	3	3	0	17
1968	0	1	4	8	3	3	0	19
1969	0	0	3	2	4	1	0	10
1970	1	3	6	4	1	2	1	18
1971	1	1	7	4	2	2	1	18
1972	1	0	1	6	2	1	1	12
1973	0	3	4	1	3	1	0	12
1974	1	3	3	6	2	2	0	17
1975	0	2	4	5	3	1	1	16
Total	4	17	36	44	29	18	4	152
Average	0.4	1.7	3.6	4.4	2.9	1.8	0.4	15.2

*Cyclone ascribed to the month in which it began.

Table 3.--Number of Eastern Pacific tropical storms reaching hurricane intensity by months and years.*

Year	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
1966	0	1	0	4	2	0	0	7
1967	0	1	0	3	1	2	0	6
1968	0	0	0	3	3	1	0	6
1969	0	0	1	1	1	1	0	4
1970	1	0	1	1	0	1	0	4
1971	1	1	5	2	3	1	0	13
1972	1	0	0	6	1	0	0	8
1973	0	1	3	0	3	1	0	7
1974	0	2	2	4	2	1	0	11
1975	0	1	2	3	1	1	0	8
Total	3	7	14	26	14	9	0	73
Average	0.3	0.7	1.4	2.6	1.4	0.9	0.0	7.3

*Cyclone ascribed to the month in which it began.

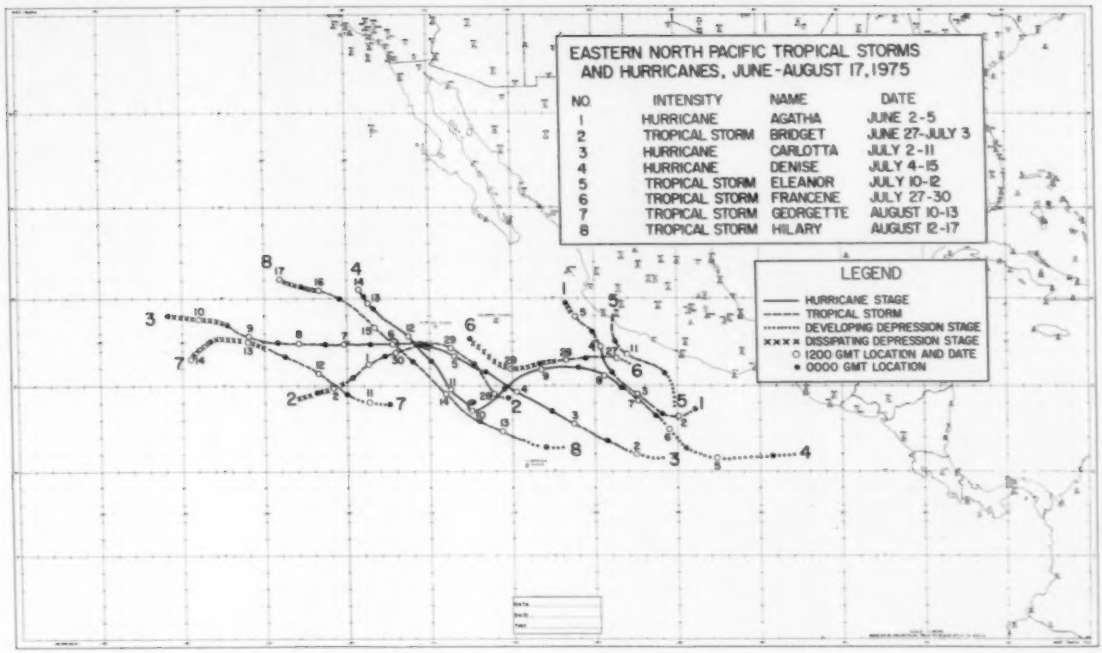

Figure 1.--Tracks of eastern North Pacific tropical cyclones, June - August 17, 1975.

tolerance indicated in the previous bulletin.

Infrared pictures were made into movie loops. The process consisted of making three exposures of each 30-min interval picture, or 44 pictures daily. Pictures were not available for 2 hr each day because of routine maintenance programs. The movie loop gave a running time of about 10 sec for the 22-hr period. It showed the progress of the storm or suspected area as well as any change in intensity. Direction and speed as well as development could be watched as the loop repeatedly fed through the projector. Loops were prepared four times daily and were available before bulletins and advisories were issued.

When storms were near the Mexican coast, merchant vessel reports were extremely valuable in helping to locate them, but only peripheral reports were received. Hopefully, this was because of the value and use of advisories and bulletins. Elsewhere, off the major shipping routes, vessels were seldom within 300 mi of the cyclone centers.

The storm tracks are shown in figures 1 and 2.

The only reported casualties were from hurricane Olivia. Tropical storm Eleanor moved onshore about 30 mi southeast of Manzanillo with 35-kn winds during the evening of July 11. Hurricanes Katrina and Lily passed a few miles southwest of Socorro Island--Katrina on September 2 with 90-kn winds, and Lily on September 18 with 75-kn winds. No reports of casualties or damage have been received.

Hurricane Olivia moved onshore near Mazatlan during the evening of October 24. Thirty thousand people were made homeless in the loss of 7,000 dwellings in Mazatlan and 14 nearby villages. Five hundred people were injured and 10 killed on shore. An additional 20 persons were lost on three shrimp boats that apparently were overwhelmed by the storm. A total of 50,000 people were removed in military vehicles from low-lying areas in and around Mazatlan before the storm hit, indicating the effectiveness of the forecasts.

The tuna boat BLUE PACIFIC encountered Olivia as she developed hurricane intensity. Some deck equipment was swept overboard or damaged by heavy seas, but when the storm passed, she was able to continue fishing.

No reports of damage to merchant vessels or their cargo have been received. A summary of the salient features of the 1975 season is included in table 4.

Reconnaissance flights contributed to the overall observation program. The June 5 flight into Agatha confirmed the fact that she was weakening. The October 24 flight into Olivia was a great help in determining the course, speed, and intensity of that hurricane.

HURRICANE AGATHA, June 2-5

A number of tropical disturbances were charted in the eastern North Pacific Ocean during the last 2 wk of May, but the areas of squalls and thunderstorms would build, die, and rebuild several hundred miles from the initial point on successive days.

An area about 250 mi southwest of Acapulco showed signs of greater instability than the others on June 1. Windspeeds of 25 kn were reported by the PRESIDENT JEFFERSON at 15.1°N, 97.3°W, at 1800. At 0000 on the 2d, the SHUNYO MARU reported an east-southeasterly 25-kn wind and a 1005.4-mb pressure in the

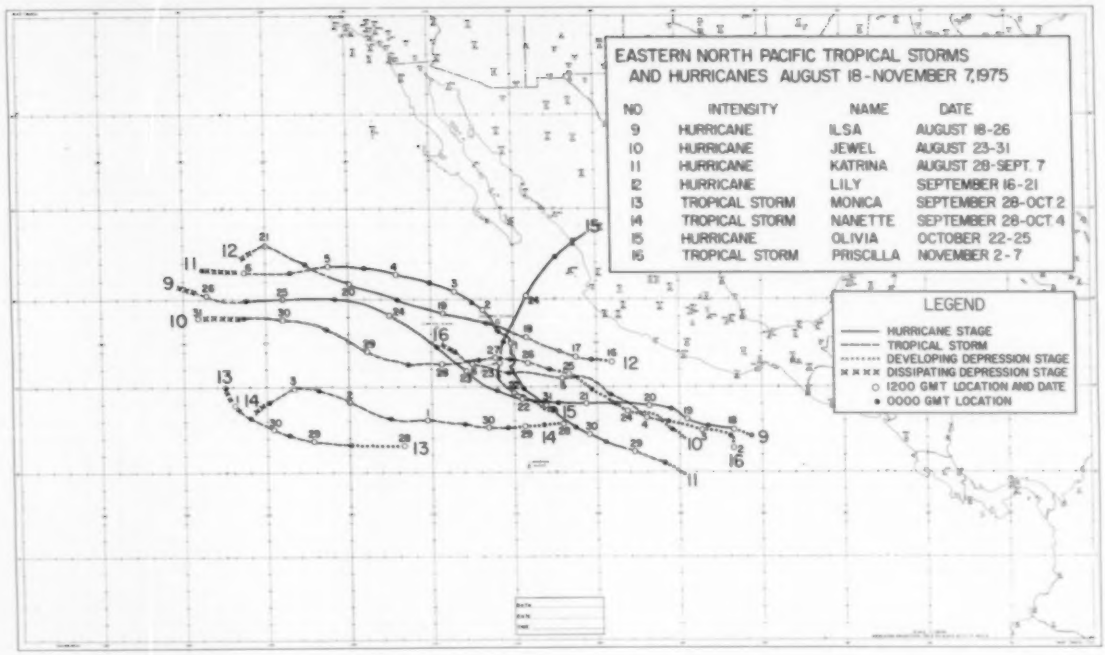

Figure 2.--Tracks of eastern North Pacific tropical cyclones, August 18 - November 1975.

same area. No other vessels reported in the area, but the 2345 SMS-2 photograph indicated a tropical depression with 30-kn winds, close to 13.5°N, 99°W. Film loops showed its movement to be toward the west-southwest at 12 kn. The LOW was forecast to curve westward and then northwestward, and to intensify.

When the depression reached its southernmost point, near 13.1°N, 100.4°W, at 0600 on the 3d, it increased to tropical storm intensity with 35-kn winds and was named Agatha. Further intensification took place, with winds increasing about 5 kn each 6 hr through 1800 on the 3d, during which time the storm traveled on a northwesterly course at a speed of about 10 kn. A satellite picture at 2116 showed development to hurricane intensity near 15.4°N, 103.7°W, about 150 mi southwest of Zihuatanejo, with 65-kn winds and gales out to 250 mi in the northeast quadrant and 125 mi elsewhere.

The strongest winds suggested by satellite pictures were 70 kn at 0000 on the 4th. The hurricane continued into the night but decreased to tropical storm strength at 1200. An apparent jog in the track was the result of difference in the location of the center between nighttime infrared and daytime visible-spectrum pictures. Figure 3 shows Agatha shortly after being downgraded from a hurricane.

After analyzing all the data and forming the "most probable track" of the storm, it was decided that the northeasterly movement was probably indicated as a result of a slight error in the storm's location at 0600 and 1200 on the 4th. These errors were translated to the forecast which then placed the storm onshore near Puerto Vallarta, about 0600 on the 6th. At 1800 on

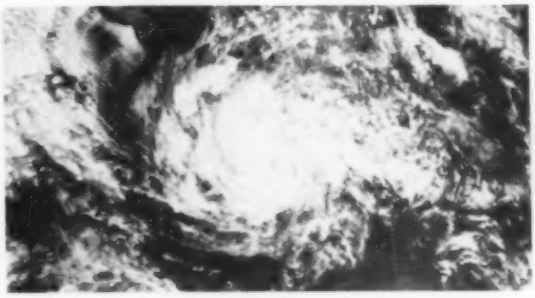

Figure 3.--Tropical storm Agatha at 1745 on June 4, near 17.8°N, 104.9°W, shortly after being downgraded from a hurricane. Agatha was the first tropical cyclone viewed from SMS-2 (Synchronous Meteorological Satellite), parked over the Equator at 115°W--an ideal vantage point for viewing eastern North Pacific tropical cyclones.

the 4th, a new track was developed with the storm continuing northwestward from near 18°N, 105°W.

Agatha weakened to a tropical depression at 1200 on the 5th. At 1800, the center was analyzed at 19.2°N, 106.4°W, based on 20- to 25-kn winds reported by the J. V. CLYNE, the MELVILLE, and the NORDIC HERON. The storm dissipated about 120 mi south of the Tres Marias Islands.

TROPICAL STORM BRIDGET, June 27 - July 3

A tropical depression developed about 500 mi south

Table 4.--Eastern North Pacific tropical cyclone statistics, 1975

Cyclone Name/ Number	Lifespan From:	To:	Date-Time of Classification/Location: Depression	Storm	Hurricane	Storm	Depression	Ended	Highest Wind Speed-Kn	From:	To:
Hurricane Agatha	2 June	5 June	020000 13.5N 99.0W	021800 13.2N 111.0W	040000 15.8N 104.1W	041200 17.2N 104.7W	051800 19.7N 106.7W	060000 19.7N 106.7W	70	040000 15.8N 104.1W	040600 16.6N 104.7W
Tropical Storm Bridget	27 June	3 July	271800 14.5N 110.0W	281200 14.7N 110.0W			020600 15.2N 120.2W	030600 14.4N 122.5W	55	301800 16.8N 117.3W	010000 16.7N 117.6W
Hurricane Carlotta	2 July	11 July	020600 10.8N 101.0W	021800 11.4N 103.4W	031800 13.2N 107.0W	080000 17.4N 121.3W	100000 18.4N 127.3W	110000 18.4N 127.3W	110	051200 16.7N 113.5W	061200 17.4N 117.2W
Tropical Cyclone Four	2 July	3 July	021800 11.7N 134.3W					031200 10.5N 136.5W	25	021800 11.7N 134.3W	031200 10.5N 136.5W
Hurricane Denise	4 July	15 July	041800 11.0N 93.0W	070000 13.3N 101.3W	071800 14.6N 102.8W	131200 19.7N 118.7W	141800 20.6N 119.2W	150000 20.8N 119.0W	120	091200 16.0N 108.1W	091800 15.5N 109.4W
Tropical Storm Eleanor	10 July	12 July	101800 14.7N 100.2W	110000 15.8N 100.8W				120000 17.6N 103.8W	35	110000 15.8N 100.8W	120000 17.6N 103.8W
Tropical Storm Francene	27 July	30 July	270600 16.3N 102.8W	271200 16.5N 103.7W			281800 16.3N 107.5W	300000 17.7N 112.5W	45	271800 16.5N 104.5W	281200 16.4N 107.8W
Tropical Storm Georgette	10 Aug	13 Aug	110000 14.0N 117.5W	111800 14.4N 119.5W			130600 17.4N 125.3W	140600 16.8N 129.3W	40	120600 15.0N 121.7W	130000 16.7N 123.7W
Tropical Storm Hilary	12 Aug	17 Aug	121800 11.4N 107.0W	130600 12.0N 109.5W			161200 20.3N 121.7W	171200 21.0N 124.0W	50	150000 16.4N 117.0W	150600 17.5N 117.4W
Hurricane Ilsa	18 Aug	26 Aug	180000 12.1N 95.8W	181200 12.3N 97.0W	210000 14.0N 104.0W	260000 19.7N 126.1W	261800 20.3N 129.9W	261800 20.3N 129.9W	95	230000 14.7N 110.0W	230600 15.2N 112.0W
Hurricane Jewel	23 Aug	31 Aug	231800 12.0N 100.0W	251800 15.8N 107.1W	271200 16.5N 111.0W	271800 16.5N 111.5W	310000 19.0N 126.2W	311800 19.0N 129.0W	65	271200 16.5N 111.0W	271800 16.5N 111.5W
Hurricane Katrina	28 Aug	7 Sept	281800 10.0N 100.0W	290000 10.5N 101.0W	291800 11.5N 103.7W	050600 21.8N 121.1W	061200 21.6N 126.3W	070000 21.6N 128.9W	115	031200 20.4N 113.7W	031800 20.7N 114.5W
Tropical Cyclone Thirteen	12 Sept	16 Sept	120000 19.5N 109.5W					160000 23.3N 115.2W	30	130000 19.5N 109.5W	141800 21.0N 110.2W
Hurricane Lily	16 Sept	21 Sept	161200 16.3N 104.2W	161800 16.4N 105.0W	181800 18.2N 110.3W	201800 21.4N 121.1W	211800 22.5N 126.0W	211800 22.5N 126.0W	75	190000 18.6N 111.6W	200000 20.0N 117.0W
Tropical Storm Monica	28 Sept	2 Oct	281200 11.5N 117.8W	290000 11.7N 120.0W			010600 13.5N 126.5W	020000 15.0N 127.3W	45	301800 13.0N 125.3W	010000 13.3N 126.0W
Tropical Storm Nanette	28 Sept	4 Oct	281200 12.8N 107.0W	291800 12.7N 110.0W			040000 14.0N 125.0W	040000 14.0N 125.0W	50	301800 12.7N 112.3W	010000 12.8N 113.0W
Tropical Cyclone Seventeen	16 Oct	17 Oct	161800 18.1N 111.1W					171200 18.0N 111.0W	25	161800 18.1N 111.1W	171200 18.0N 111.0W
Hurricane Olivia	22 Oct	25 Oct	220000 13.7N 107.6N	220600 14.0N 109.0W	231800 17.0N 110.8W			250600 23.2N 106.3W	100	250600 23.2N 106.3W	Onshore
Tropical Cyclone Nineteen	1 Nov	2 Nov	010600 12.8N 99.2W					021800 14.3N 102.7W	25	010600 12.8N 99.2W	021800 14.3N 107.7W
Tropical Storm Priscilla	2 Nov	7 Nov	020000 11.5N 97.0W	040600 13.2N 101.6W				070000 17.0N 113.7W	55	051800 15.6N 108.7W	070000 17.0N 113.7W

of the tip of Baja California, well west of the usual area of formation for tropical cyclones, at 1800 on June 27.

As usual, initial movement of the depression was uncertain, but a general westerly direction was followed at a speed of 6 kn for the first 12 hr. When the depression intensified to tropical storm Bridget, near 15°N, 111°W, at 1200 on the 28th, its course changed to northwesterly, and the speed increased to 8 to 10 kn. This movement continued as gradual intensification took place. The KOPAA, heading southeastward, sailed southwest and south of the center, on the morning of the 29th, when Bridget had 50-kn winds (fig. 4). The highest windspeed the KOPAA reported was 25 kn at 1800 on the 29th and at 0000 on the 30th.

Bridget changed to a westerly course at 17.3°N, 115°W, after the KOPAA passed, and then southwesterly, approaching no other vessel as a storm. The CHAO MING outran the storm westbound on July 1 and 2, reporting regularly as she traveled.

At 0600 on the 2d, Bridget became a depression near 15°N, 120°W, with 30-kn winds. Continued cloudiness, somewhat supported by reports from fishing vessels in the area, indicated that a circulation remained for several days near 14.4°N, 122.5°W, but there were insufficient data to warrant upgrading the circulation to tropical depression status.

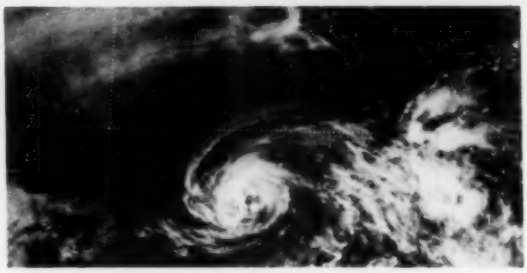

Figure 4.--Fifty-knot winds were estimated from this picture of tropical storm Bridget taken at 1645 on June 29 by SMS-2 satellite. The center was near 17.3°N, 114.3°W.

HURRICANE CARLOTTA, July 2-11

As tropical storm Bridget passed 100 mi south of Clarion Island, headed west-southwestward, an area of squalls and thunderstorms began developing 420 mi south-southeast of Acapulco. The cloudiness was moving west at about 10 kn and was indicated in high-seas bulletins to develop as a tropical cyclone. Special bulletins were begun at 0600 on the 2d for tropical depression Three which was forecast to become a tropical storm in 24 hr. The KOPAA reported 25-kn winds in squalls 130 mi north of the center at 0900 on the 2d and 35-kn winds 150 mi northeast of the center at 1500. This report suggested that the depression had intensified to tropical storm Carlotta.

Further intensification was almost in textbook style. The storm was moving toward the west-northwest and northwest at 10 to 12 kn, becoming a hurricane with 65-kn winds near 12.5°N, 108.2°W, by 1800 on the 3d, and with 100- to 110-kn winds from 0000 on the 5th at 15.8°N, 111.7°W, through 1800 on the 6th at 17.3°N, 117.9°W (fig. 5).

Weakening began about 0600 on the 6th, but the ERIDGE reported south-southwesterly winds of 45 kn, 200 mi southeast of the center, at 1200 on the 7th, when the hurricane still contained winds of 75 kn. Tropical storm intensity began at 0000 on the 8th with 35-kn winds.

The SHINYU MARU and the DAISHIN MARU reported well south of the center at 0000 and 0600 on the 8th, but these reports indicated no more than a storm at some distance to the northwest.

The KRAIGHER B passed 120 mi north of Carlotta, at 0900 on the 9th, and had 30-kn winds until about 200 mi east of the center. She then altered course to pass south of oncoming Denise, 900 mi east-northeast of Carlotta.

Carlotta became a depression at 0000 on the 10th. The CHEVRON AMSTERDAM overtook the weakening depression during the night of the 10th, 180 mi south of the center.

Figure 5.--A classic cloud pattern for an eastern North Pacific hurricane is displayed by Carlotta near 17.0°N, 114.5°W, at 1645 on July 5. Winds of 110 kn are suggested by the diameter and banding shown in this SMS-2 photograph.

HURRICANE DENISE, July 4-15

No other vessels were near the center of a large unstable area, near 11°N, 93°W, at 1800 on the 4th, but reports from the AMERICAN LANCER, CHEVRON AMSTERDAM, KOPAA, and SAN JUAN EXPORTER indicated a circulation had developed. The depression was followed west and northwestward on satellite pictures and charted as a tropical depression with the aid of peripheral reports from the AMERICAN LEADER, ASTRID BAKKE, CEDARBANK, CHEVRON AMSTERDAM, MARITIME JET, RICE QUEEN, SANTA MAGDALENA, and the UNIWERSYTEL WARZAWSK, through 1800 on the 6th, near 13°N, 101°W.

At 0000 on the 7th, the depression intensified to tropical storm Denise, with 45-kn winds reported by PGXY, 30-kn winds by the EURYBATES, and 20-kn winds by the PRUD OCEANJET. As the storm reached 15°N, 103°W (200 mi south of Manzanillo), at 0000 on the 8th, its course changed to more westerly.

Figure 6.--With proper gridding there can be no doubt where hurricane Denise was centered at 1656 on July 11. She still packs 80-kn winds in this picture, 48 hr after reaching a maximum intensity of 120 kn.

At this time the storm was considered a hurricane. Although winds along the coast, from Cape Corientes to Acapulco, are normally strong southeasterlies under these circumstances, they were reported as only 15 to 25 kn. The hurricane steadily increased in intensity to 120 kn, by 1200 on the 9th, with the strongest reported winds of only 30 kn by the PLEIAS and the FIDELITY R at 1800 on the 9th. The course of the hurricane then changed to southwesterly, and it weakened slowly. The PSDY sent a SHRED report of northwesterly winds of 45 kn from 150 mi west of the center at 0000 on the 10th. The storm continued southwestward, slowly weakening and becoming nearly stationary, from 1800 on the 10th to 0600 on the 11th, near 13.7°N, 113.5°W. After the 12-hr "stationary" period, Denise began moving northwestward at about 10 kn.

At 1800 on the 11th, the CABRILLO, a tuna boat just off Clarion Island, was headed southwestward as Denise, with 80-kn winds some 200 mi to the south, was moving northwestward (fig. 6). The CABRILLO, aware of the location and intensity of the storm, contacted the Hurricane Center for information and advice. The storm and boat were on an intercept course with the meeting scheduled for 0500 on the 12th. The advice was to sail east for 6 to 12 hr and then resume the southwesterly course. The CABRILLO reports regularly in the Tuna Fleet and is an old hand at evading tropical cyclones.

At 0000 on the 12th, the CETRA LYRA was about 100 mi east of the hurricane and moving northwestward at about the same speed as Denise. She reported 40-kn winds. These increased to 60 kn, by 0000 on the 13th, when the CETRA LYRA reported the lowest pressure in the storm--993 mb. She altered her course to pass 120 mi south of the center, at 1800 on the 13th, with 30- to 40-kn winds.

By the time Denise reached 19.7°N, 118.7°W, she had weakened to tropical storm intensity, and she became a depression near 20.6°N, 119.2°W, at 1800 on the 14th, and dissipated 6 hr later.

TROPICAL STORM ELEANOR, July 10-12

A persistent area of thunderstorms 120 mi south of Acapulco, at 1800 on the 10th, led to issuing a bulletin on tropical depression Six. Movie loops of satellite pictures showed cyclonic circulation with signs of intensification, so the depression was upgraded to tropical storm Eleanor. Acapulco reported 30-kn winds, at 1200 and again at 1800 on the 10th, but vessels reporting in the area were not numerous enough to pinpoint the location of the center.

Eleanor moved north-northwestward for 6 hr, northward for 18 hr, and then northward to go onshore near Manzanillo, at about 0500 on the 12th (fig. 7). At 0000, the LUDWIGSHAFEN reported a 998.6-mb pressure about 75 mi southeast of the center, and the

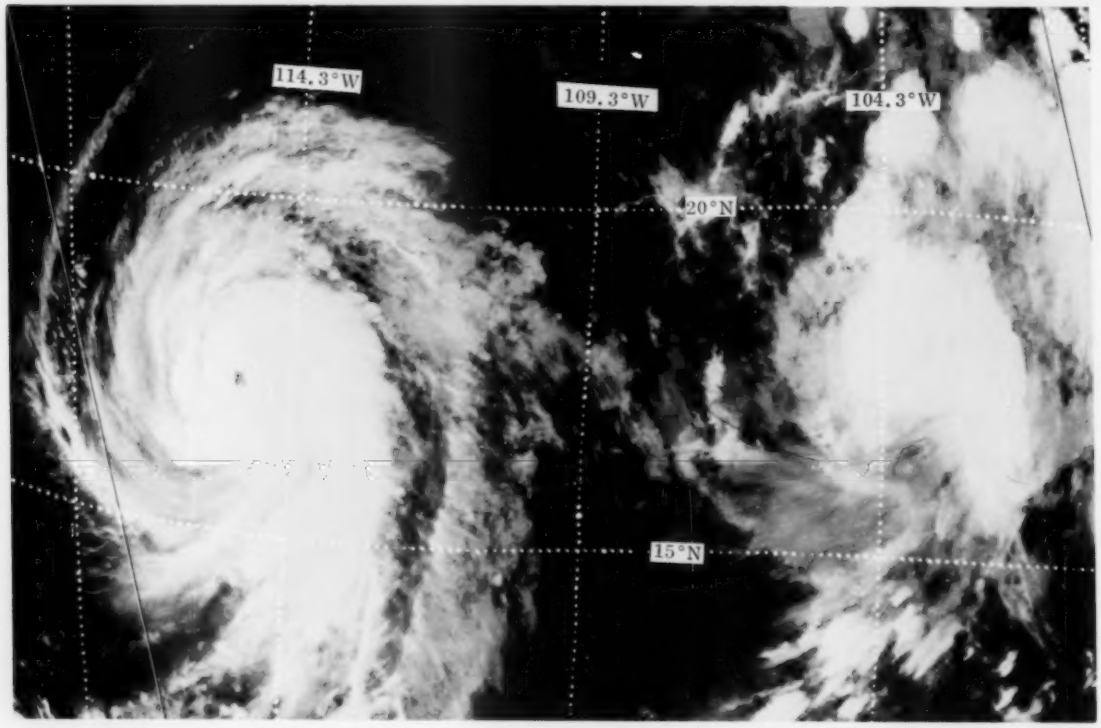

Figure 7.--The eye of hurricane Denise is clearly evident near 17.2°N, 115°W, while the center of tropical storm Eleanor, near 18°N, 104°W, is more difficult to determine. Eleanor, 60 mi south-southeast of Manzanillo, was moving northward at 20 kn at the time this high-resolution infrared NOAA-4 image was taken at 0339 on July 12.

FERNFIELD reported 30-kn winds 30 mi south of the center. Manzanillo reported westerly 15-kn winds 20 mi northwest of the center.

No damage was reported to vessels, and it is not believed rainfall was heavy enough to cause more than minor damage to shore installations.

TROPICAL STORM FRANCENE, July 27-30

Tropical storm Francene began as a disturbance near 11.5°N, 95°W, about 1200 on July 25, moving northwestward at 20 kn, with winds of 30 kn in squalls. The disturbance continued on a northwesterly track but slowed as it organized and intensified to tropical depression Seven, at 0600 on the 27th, near 16.4°N, 102.8°W. The track became more westerly, and the depression developed to tropical storm Francene near 16.5°N, 103.7°W, at 1200 on the 27th (fig. 8). A westerly movement continued for 24 hr when Francene weakened to a depression. The depression curved northwestward, and its speed increased to 15 kn as weakening continued. By 0000 on the 30th, only a minor circulation was indicated in satellite pictures, so bulletins were discontinued. A tropical disturbance was indicated in high-seas bulletins for another 12 hr; then even these were dropped.

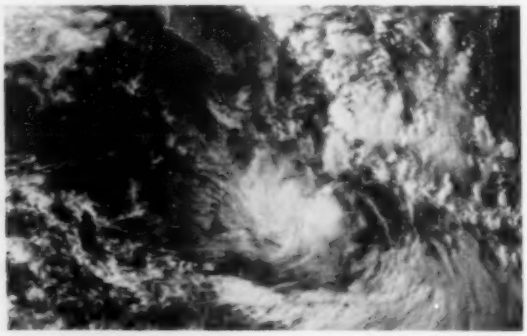

Figure 8.--Tropical storm Francesca at 2345 on July 27 near 16.5°N, 104.5°W, with 45-kn winds. Movie loops showed a circulation that is not evident in this single frame.

TROPICAL STORM GEORGETTE, August 10-13

Georgette began as a tropical depression about 700 mi southwest of Cape San Lucas, late on August 10. She was headed westward at about 5 kn with 25-kn winds. Tropical storm intensity was reached 24 hr later, at 1800 on the 11th, near 14.4°N, 119.5°W, where the course curved gently northward, and the speed increased to 8 to 10 kn. Maximum winds of 40 kn were indicated from 0600 on the 12th to 0000 on the 13th (fig. 9), when slow weakening began.

The track then curved westward again with a forward speed of 10 to 12 kn. When the storm reached 17.4°N, 125.3°W, at 0600 on the 13th, the intensity dropped to depression stage. Further weakening continued through 0600 on the 14th, when bulletins were discontinued.

No reporting vessels approached nearer than 300 mi of the cyclone.

Figure 9.--Nebulous tropical storm Georgette, at 16°N, 122.5°W, with 40-kn winds (left); tropical depression Nine, later Hilary, at 11.4°N, 107°W (center); and thunderstorm activity over Mexico near Manzanillo (right) at 1915 on August 12.

TROPICAL STORM HILARY, August 12-17

The gradual organization of a tropical disturbance, near 11°N, 103°W, was noticed in satellite pictures on August 11. A circulation had developed by 1800 on the 12th. It was moving west-northwestward at 8 to 10 kn, and tropical depression Nine formed near 11.4°N, 107°W, with 30-kn winds in squalls and thunderstorms near the center.

The depression increased to tropical storm intensity and was named Hilary at 0600 on the 13th. Winds of 40 kn were estimated from satellite pictures, and the center, moving northwest at 10 kn, was indicated near 12°N, 109.5°W. The northwesterly movement continued, and its forward speed increased to 14 kn as winds near the center increased to 50 kn, at 0000 on the 15th, near 16.5°N, 116°W (fig. 10).

Weakening followed the northwestward acceleration, with the center reaching 20.3°N, 121.7°W, at 1200 on the 16th, when the storm became a depression with 30-kn winds. The center began curving west-northwestward as weakening continued. Dissipation was near 21°N, 124°W, at 1200 on the 17th.

Gale winds were reported by an unidentified vessel with 1007-mb pressure about 100 mi northwest of the center, at 0000 on the 13th, while the cyclone was still classified as a depression. The GALILEO GALILEI, 150 mi south of the center, reported 15-kn winds at 0600 on the 13th. No other vessels reported within the circulation of the cyclone.

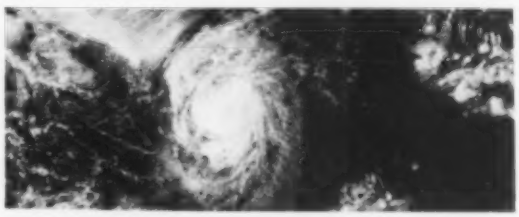

Figure 10.--Tropical storm Hilary at peak intensity at 2345 on August 14 near 16.5°N, 116°W. Maximum winds of 50 kn near the center were inferred from this photograph.

HURRICANE ILSA, August 18-26

A disturbance that apparently crossed Central America between 8° and 13°N was followed westnorthwestward from near 7°N, 83°W, beginning August 16. It was moving at about 20 kn, and a weak circulation was suggested by reports from the AMERICAN AQUARIUS and the DEVON CITY. Reports from the RIGOLETTO and DEVON CITY, at 1800, indicated it had moved to 9°N, 89°W, but the windspeeds reported were only 5 to 10 kn. By 1200 on the 17th, the disturbance was indicated by satellite pictures to be near 12°N, 94°W, and the windspeeds had increased to 10 to 20 kn at points 100 to 150 mi of the center of the shower and thunderstorm activity. Six hours later, the PORTMAR and ELISABETH BOLTEN added their reports indicating further intensification.

By 0000 on the 18th, reports from the UNIQUE FORTUNE indicated that tropical depression Ten had formed near 12.1°N, 95.8°W, and was moving westnorthwestward at about 8 kn. By 1200 on the 18th, the depression had intensified to tropical storm Ilsa, near 12.3°N, 97°W. Movement continued west-northwestward at 8 to 10 kn, but a more westerly track was observed as intensification took place. The storm became a hurricane near 14°N, 104°W, at 0000 on the 21st, on a course of 280° at 9 kn.

Intensification continued with winds reaching 85 to 95 kn from 1200 on the 22d through 0600 on the 25th (fig. 11). Ship reports were few. A Chinese vessel reported 30- to 40-kn winds as it passed 200 mi south of the center on the 23d.

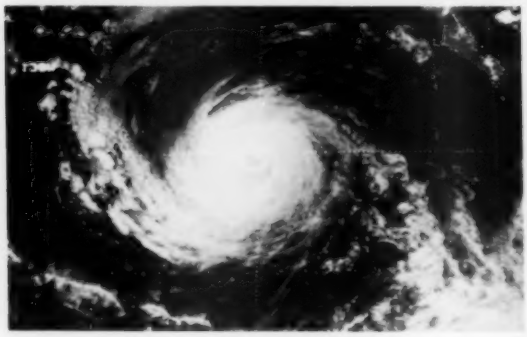

Figure 11.--Hurricane Ilsa with 90-kn winds at 2145 on August 24. Locating storm centers has been much easier since satellite pictures have been available.

The track curved northwestward at 10 kn, from 1800 on the 22d through 1800 on the 24th, then westward again. Weakening began at 0600 on the 25th and was rapid. Ilsa became a tropical storm near 19.7°N, 126.1°W, at 0000 on the 26th, and a depression by 1800 near 20.3°N, 129.9°W.

The remnants of Ilsa were followed westward in satellite pictures and with the aid of reports from the AVOCET, CHAO MING, HAWAIIAN MONARCH, MALLORY LYKES, MATSONIA, ORONSAY, PRINCE MARU No. 7, SHOZEN MARU, and the SILVEROON to near 29°N, 153°W, by 1800 on the 31st, but no reports were for more than 25-kn winds.

Tropical storm appearance began again on September 3 when VHRR (Very High Resolution Radiometer) pictures showed an intense circulation, complete with an eye, near 38°N, 158°W, and 35-kn winds were reported by the HAGOROMO MARU at 1800, 45-kn winds by the PLUVIUS, and 35-kn winds by the TRANSCOLORADO at 0000 on the 4th. At 0600 on the 4th, 55-kn winds were reported by the TRANSCOLORADO. The LOW moved northeastward and dissipated in the Gulf of Alaska.

HURRICANE JEWEL, August 23-31

While Ilsa was churning her way northwestward, 400 mi southwest of Cape San Lucas, a tropical disturbance formed about 300 mi south of Acapulco. Initial reports from the PRUD OCEANJET and the KRYPTOS indicated winds to 30 kn in squalls, at 1800 on the 23d, and suggested tropical depression Eleven had formed. The depression was moving west-northwestward at 12 kn, but slowed to about 5 kn by 1800 on the 25th, forming tropical storm Jewel during the deceleration.

The course changed to westerly at 5 to 8 kn, and intensified to a marginal hurricane by 1200 on the 27th (fig. 12). Slow weakening and acceleration westnorthwestward continued, through 0000 on the 31st, to tropical depression strength near 19°N, 126.2°W. Bulletins on the depression were discontinued after 1200 on the 31st, but remnants of the circulation were still visible in satellite pictures until September 3.

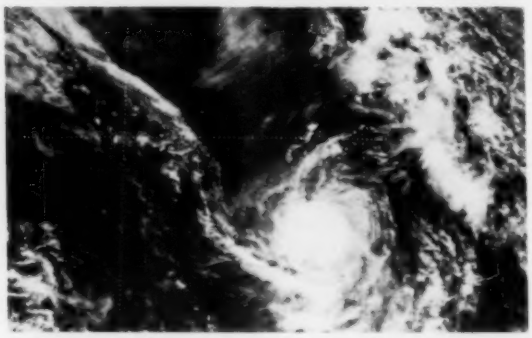

Figure 12.--Tropical storm Jewel at 1845 on August 27 just after peak intensity. Earlier infrared pictures indicated hurricane winds were near the center.

HURRICANE KATRINA, August 28 - September 7

Tropical storm Jewel was working her way westward some 400 mi southwest of Cape San Lucas, and Ilsa was a tropical depression 1,000 mi east of Honolulu, at 1800 on the 28th, when a rapidly developing tropical depression formed 400 mi south of Acapulco. Successive satellite pictures of Katrina indicated a west-northwesterly 10-kn movement, and hurricane intensity was forecast within 48 hr, but was reached sooner, at 1800 on the 29th, near 11.5°N, 103.7°W.

The track of Katrina turned more northwesterly,

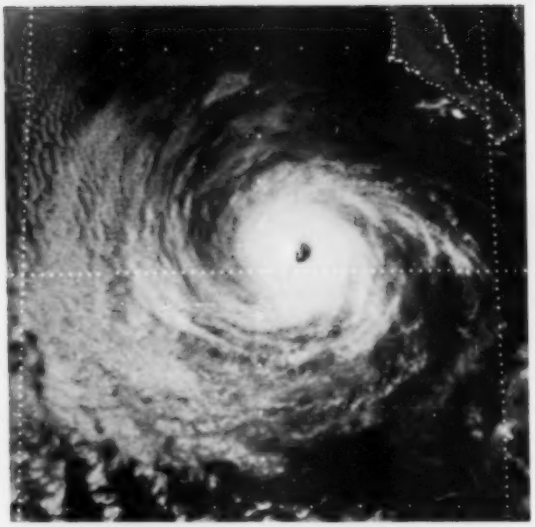

Figure 13.--Hurricane Katrina with 115-kn winds at 1545 on September 3 near 20.4°N, 114.2°W. Katrina lived long--162 hr as a hurricane.

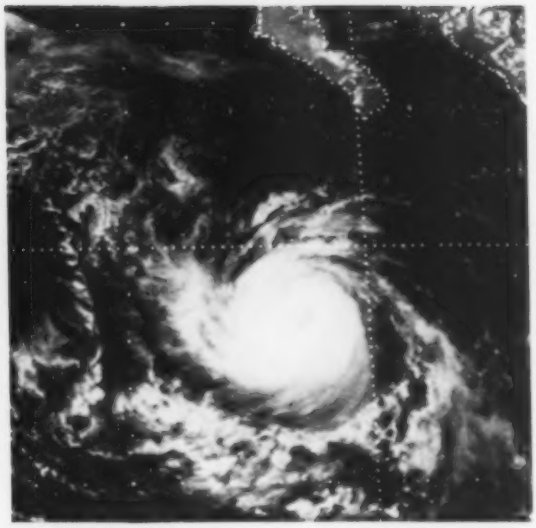

Figure 14.--Hurricane Lily with 70-kn winds at 2215 on September 18.

and gradual intensification continued. Winds of 80 kn were indicated when the center was 150 mi southeast of Socorro Island at 1200 on September 1, and 115 kn when the center was 180 mi northeast of Socorro Island at 1200 on the 3d (fig. 13).

Following the peak intensity, at 1200 on the 3d, weakening began, and the course became westerly. The hurricane was downgraded to a tropical storm, at 0600 on the 5th, near 21.8°N, 121.1°W. Dissipation was almost as rapid as its earlier development. Tropical depression stage was reached, by 1200 on the 6th, and bulletins were discontinued at 0000 on the 7th.

HURRICANE LILY, September 15-21

Rain and an easterly wind at Acapulco, at 1200 on September 15, suggested a tropical disturbance offshore. The 1800 reports from the DEVON CITY, MARITIME ACE, and JOHAN U verified a circulation center near 16°N, 102°W, moving westward at 10 kn, and forecast to be a tropical storm within 24 hr. It took only 18.

Satellite pictures included enough features to consider Lily a tropical storm about 150 mi south of Manzanillo, by 1800 on the 16th, with winds estimated at 35 kn. Soon after forming, Lily curved slightly northwestward, slowed to about 5 kn for 30 hr, and increased in intensity to 50 kn, by 0000 on the 18th, 200 mi southwest of Manzanillo.

A west-northwesterly track continued with no surface vessels reporting near the storm. At 1800 on the 18th, Socorro Island reported a northeasterly wind of 30 kn. When the center was 60 to 75 mi to the southeast, Lily was upgraded to a hurricane (fig. 14).

Socorro Island reported easterly winds which increased to 70 kn, by 0000 on the 19th, as Lily passed to the south and west of the Island. The storm was then moving west-northwestward at about 12 kn.

That track continued as the hurricane slowly weakened to a tropical storm with 60-kn winds, at 1200 on the 20th, and to a tropical depression with 25-kn winds, 24 hr later, near 22.5°N, 126°W. The remains of Lily drifted west-southwestward in the northeast trades, and all traces of her were lost by the 24th.

TROPICAL STORM MONICA
September 28 - October 2

Three tropical disturbances were indicated in satellite pictures at 1800 on September 27. They were centered near 13°N, 125°W; 11°N, 115°W; and 14°N, 106°W; and were moving westward at 10 kn. The disturbance that was initially near 125°W dissipated by 0600 on the 28th. The IRISH MAPLE, at 11°N, 114°W, at 0000 on the 28th, reported southwesterly winds of 10 kn and, slowly closing on the disturbance, reported southwesterly winds of 15 kn about 75 mi from the center of activity, which was estimated near 12°N, 117°W, at 0600. The IRISH MAPLE's pressure had been falling at a rate of 1 mb per hr, and the wind had increased to 40 kn by 1800, indicating tropical storm Monica had formed.

The storm continued tracking westward at about 12 kn, passing near the OCEANOGRAPHER at 0600 on the 29th. The IRISH MAPLE reported 30-kn winds about 100 mi from the center, near 12.3°N, 123°W, at 1800 on the 29th, as Monica continued to travel on a course a little north of west. The strongest wind in the storm was 45 kn indicated by satellite pictures, at 1800, near 13°N, 123°W.

Monica continued westward to 13.9°N, 126.5°W, by 0600 on October 1, when she was downgraded to a depression, and bulletins were discontinued. The disturbance continued westward giving the WESER heavy rain and 25-kn winds on the 2d.

After that, the remains could be seen in pictures

as the disturbance moved to 17°N, 140°W, by 1800 on the 6th. The KISHU MARU, NECTARINE CORE, and PHILIPPINE BEAR reported near the cloud cover but suggested no circulation in their observations.

TROPICAL STORM NANETTE
September 28 - October 4

The easternmost tropical depression, near 14°N, 106°W, at 1800 on September 27, was relocated farther south near 12.8°N, 107°W, at 1200 on the 28th. It moved generally westward at 8 to 10 kn and increased in intensity to become tropical storm Nanette, near 12.8°N, 110.1°W, while slowing slightly and curving a little south of west (fig. 15).

The southernmost point in the track was reached, at 1200 on the 30th, near 12.2°N, 111.8°W, after which a northwesterly and westerly track at about 10 kn continued through 0600 on October 3. Gradual intensification continued to 45 kn at 1800 on October 1 through 0600 on the 3d.

Weakening was as slow as the generation. Winds of 40 kn continued near the center until 0600 on the 3d, at 15°N, 122.5°W, when a southwesterly track began. By 0000 on the 4th, the storm became a disturbance, near 14°N, 125°W, and bulletins were discontinued.

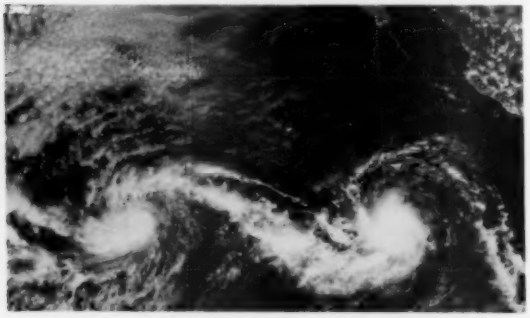

Figure 15.--Monica (left) and Nanette (right), tropical storms with winds of 35 kn at 1845 on September 29.

No vessels were near enough to the storm to report any significant weather. If it were not for satellite pictures, it is doubtful that Nanette would have been detected.

HURRICANE OLIVIA, October 22-25

Satellite pictures showed three areas of concentrated thunderstorm activity, near 13°N, 106°W, early on October 21. By afternoon, the PORTUGAL MARU and SAPPORO MARU with 1006-mb pressures, 120 and 200 mi from the center, suggested a circulation had formed. By 0600 on the 22d, tropical storm intensity was indicated in high-seas bulletins and advisories.

Further development was slow, and its movement was toward the northwest at about 12 kn to near 15°N, 111°W, by 1800 on the 22d. The circulation was well developed as indicated by reports from the PORTUGAL MARU, SAPPORO MARU, OCEAN HAPPINESS, and Socorro Island, all about 200 mi from the center. The storm was forecast to move west-northwestward and to intensify. By 0000 on the 23d, it became apparent that the track was more northerly, and a vessel reported east-southeasterly 60-kn winds at 1800, at 16.8°N, 109.7°W, about 75 mi northeast of the center (fig. 16).

The tuna boat, BLUE PACIFIC, ran afoul of Olivia near 17°N, 110°W, at 0000 on the 24th, and reported 75-kn winds with gusts to 90 kn and the loss of much deck equipment from heavy seas.

The hurricane continued curving northeastward and began to accelerate. Air Force reconnaissance, at 1322 on the 24th, reported southeasterly 79-kn winds at 9,200 ft in the southeast wall of the elliptical eye near 20°N, 109.6°W.

Northeasterly movement of the hurricane became stable at about 12 kn. The CUFIC and a Mexican Coast Guard boat reported 50-kn winds some distance from the center, as the hurricane moved toward the coast during the afternoon of the 24th (fig. 17).

The hurricane moved onshore, between 0400 and 0500, a few miles south of Mazatlan on the 25th (fig. 18). Newspaper reports indicated 50,000 people were evacuated from low-lying areas before the hurricane struck; 30,000 people were left homeless by the de-

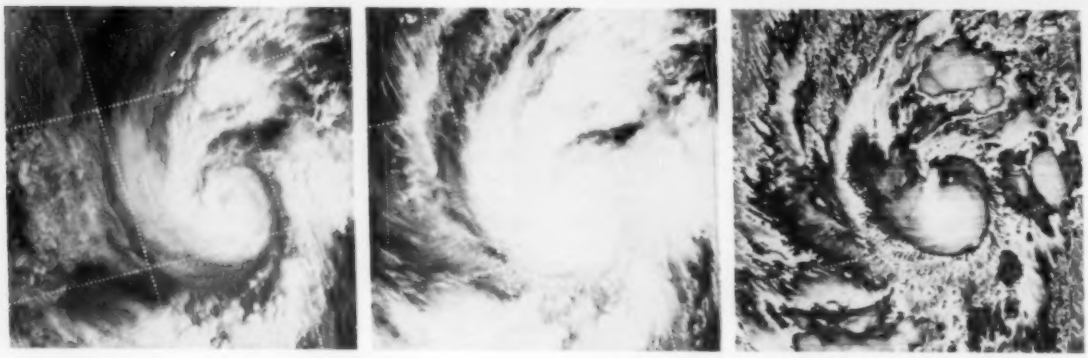

Figure 16.--Visible spectrum of Olivia at 1628 on October 23 (left) and normal infrared spectrum (center). One must keep his wits about him when examining the infrared picture at the right where several transitions from black to white indicate a fine temperature scale of energy radiated from the clouds or Earth's surface.

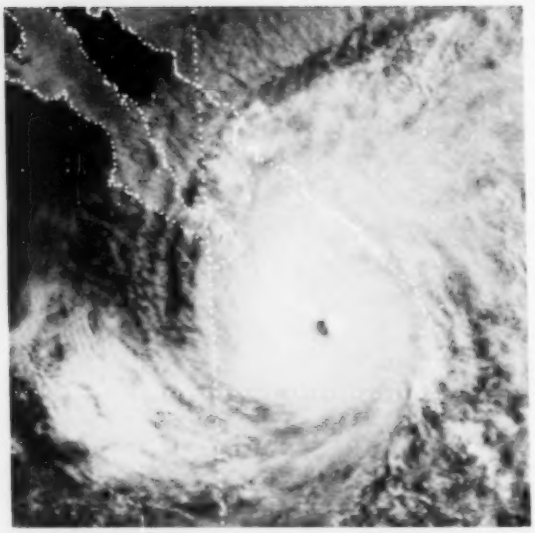

Figure 17.--Hurricane Olivia approaching Mazatlan from the southwest at 2215 on October 24 in this visible spectrum SMS-2 photograph.

Figure 18.--Pity the poor people ashore on a night like this. Hurricane Olivia over Mazatlan at 0545 on October 25. Winds of 138 mi/hr caused much damage according to newspaper reports.

struction of 7,000 dwellings in or near Mazatlan; 500 were injured and 30 killed as a result of heavy rains and 138 mi/hr winds. Twenty of the fatalities were crewmen of three shrimp boats which were lost. Monetary losses have been tentatively set at $20 million, of which $4 million was in beach and tourist areas.

Ship reports and satellite pictures made possible the positive forecasting of the storm during the 18 hr prior to its moving onshore. While damage and suffering were considerable, without the early warning, they would have been greater.

TROPICAL STORM PRISCILLA, November 2-7

A portion of a cloud mass that crossed Honduras and Guatemala during the last week in October began to organize near 11°N, 97°W. As best as could be determined, this mass of clouds remained stationary for about 18 hr, then drifted slowly north for 12 hr, gradually increasing in intensity to a depression with 30-kn winds.

As soon as a circulation was well established, the depression moved west-northwestward becoming tropical storm Priscilla, at 13.2°N, 101.6°W, at about 0600 on the 4th. The track continued in the same direction, passing 120 mi northeast of the ABEL TASMAN, at 0000 on the 5th, and continued to 15.3°N, 105.6°W, with 45-kn winds by 0600 on the 5th.

The storm was forecast to continue northwestward and then curve northward, but recurvature never occurred. After 0600 on the 5th, a more westerly track developed and winds of 55 kn were estimated from satellite pictures (fig. 19).

The SOUTHWEST CAPE reported northerly 30-kn winds 75 to 80 mi west of the center, which was near 15.6°N, 110.3°W, at 0000 on the 6th. The storm then headed northwestward, toward Clarion Island, but dissipated 100 mi short of landfall at 0000 on the 7th.

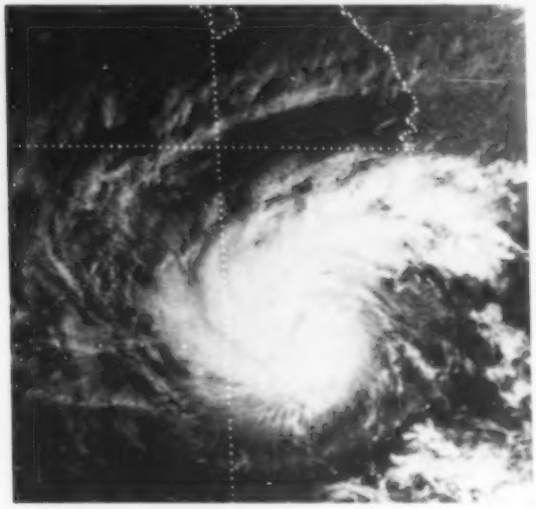

Figure 19.--The low sun angle at 1545 on November 5 indicates an eye trying to form in tropical storm Priscilla. Later pictures were too well lighted to show this feature.

HYPOTHERMIA AND COLD WATER SURVIVAL

Elwyn E. Wilson
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Hypothermia is the subnormal temperature of the body. Finding oneself in the water in midwinter is a very serious situation, even in waters of moderate temperatures in any season. Many people die with lifejackets on, not because of injury, shock, or fatigue, but because of cold. The body quickly surrenders its heat to the cold water. As the chilled blood circulates through the heart and brain, these vital organs become impaired. The body is an electrochemical machine, and the chemical reactions are slowed by cold temperatures. A slowing of the brain chemistry can cause unconsciousness, and the cooling of the heart can result in a state of electrical anarchy known as fibrillation, which can lead to death.

A research team at the University of Victoria, comprised of Dr. John Hayward, Dr. Martin Collis, and Dr. John Eckerson, conducted an extensive study of the physiological responses of the body to long-term immersion. The research included over 500 immersions in the open sea around Victoria Island at various times of the year, with water temperatures in the 38° to 65°F (4° to 16°C) range. The tests were designed to simulate accident situations.

In order to obtain a detailed physiological picture of the response of the human body to cold water, the subjects were monitored much like the astronauts. The scientists had a second-by-second picture of the body's response to cold stress. Of particular interest were the subjects' deep body temperature, tympanic temperature (approximate temperature of the blood flow to the brain), heart rate and ECG tracing, oxygen uptake, and the electrical activity of specific muscles as an index of shivering (fig. 20). Recordings were continued during the important rewarming pro-

Figure 20.--Personnel participating in the tests were wired so that their reactions to the cold water stress were constantly monitored. U.S. Coast Guard Photo.

cess.

In cold water, the skin and peripheral tissues are cooled very rapidly, but it takes 10 to 15 min before the temperature of the heart and brain begin to cool. Intense shivering occurs in an attempt to counteract the large heat loss. Unconsciousness can occur when the internal body temperature falls to approximately 90°F (32°C). When the temperature cools to near 85°F (30°C) or below, death usually occurs because of heart failure.

To highlight the critical areas of heat loss during immersion, vital information was obtained by using a thermograph-scanning technique. The thermograph shows graphic differences in the areas of heat loss when holding still in the water and when swimming.

When holding still in the water (fig. 21), the areas of high heat loss (white areas) are down the side of the chest and in a V-shape in the groin area. After vigorous swimming, the thermograph shows that the arms, shoulders, and upper chest also become areas of high heat loss. When swimming, the blood is forced to flow to the large muscles of the upper body, and it is cooled as it flows close to the surface. As it returns to the heart and deep body areas, this cooled blood in turn lowers the inner temperature of the body.

Using this information, it was discovered that survival time could be increased by approximately one-third merely by holding still in the water. In 50°F (10°C) water, a person who might survive 2 hr while swimming would have a predicted survival time of 2-3/4 hr by holding still. Further experimentation predicted that in the 50°F water the average person would be able to swim less than a mile before becoming completely incapacitated by the cold. Using the "drownproofing" survival technique (floating face down and raising the head only to breathe), the survival time is reduced to less than 1-1/2 hr. A tremendous amount of heat can be lost from the head.

Using the information obtained from the research, it was reasoned that if the critical heat loss areas could be protected, survival time would increase. A position called Heat Escape Lessening Posture (HELP) was developed (fig. 22) for those in the water alone, and the Huddle for small groups. Both positions require a life preserver. The HELP position involves holding the upper arms firmly against the sides of the chest, keeping the thighs together, and raising the knees to protect the groin area. The Huddle involves facing each other and keeping the bodies as close together as possible (fig. 23). These positions improve the survival time to 4 hr in 50°F water, approximately twice that of the swimmer and 50 percent more than the passive position.

Figure 21.--Areas experiencing heat loss (sides, groin, and neck) show up readily in this thermograph.

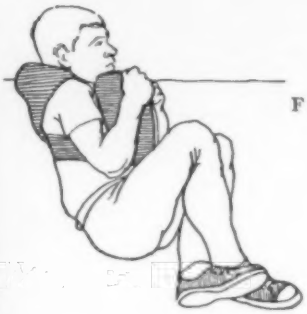

Figure 22.--Heat Escape Lessening Position

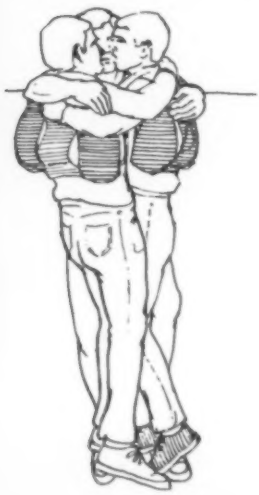

Figure 23.--Huddling position

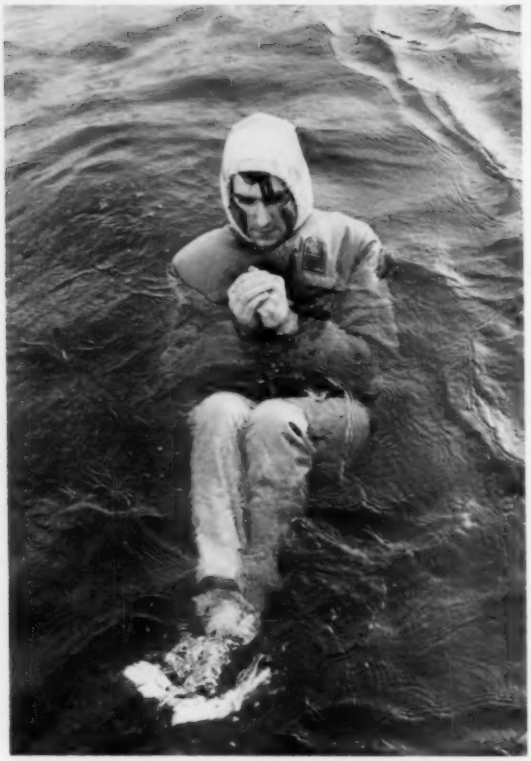

Figure 24.--One of the researchers demonstrates the floatation jacket developed by the University of Victoria in the HELP position.

Another consequence of the research was an improvement in the attractive and popular flotation jackets. A neoprene flap was hidden in the back which could be quickly converted into a pair of shorts to protect the heat loss areas in the groin. A reflective hood increases the visibility for rescue and provides some protection for the head.

Several factors other than water temperature affect the cooling rate and survival time (fig. 24). These include physical characteristics of the subject, use of personal flotation device, protection afforded by clothing, and behavior in the water. Unfortunately, once a person is in the water, he has no control over any factor except his behavior, but this can make a crucial difference. Table 5 gives an indication of the predicted survival time at three water temperatures for four conditions.

Recognition and proper treatment of hypothermia must be prompt. Delays even after rescue alive can cost a person his life. Body temperature is the best

Table 5.--Predicted survival times

Behavior	Estimated survival time, in hours, when the water temperature is:		
	40°F	50°F	60°F
No Floatation:			
Drownproofing	1.08	1.44	2.26
Treading water	1.46	1.96	3.07
Floatation:			
HELP (heat escape lessening posture)	2.87	3.80	5.96
No HELP (passively floating)	1.96	2.62	4.11

indication of hypothermia. Blood pressure and pulse are also good indicators. The pulse is generally slow and irregular.

The hypothermia victim is pale in appearance, the pupils are constricted and react poorly to light, and respiration is slow and labored. He will usually be shivering violently, with frequent muscular rigidity. There may also be an appearance of intoxication.

Emergency treatment must begin as soon as possible to stop the drop in body temperature. Wet clothing should be removed. If the body temperature is 97°F or above, no treatment other than dry clothing and moving the victim to a warm area is generally necessary. If these are not available, the wet clothing should not be removed.

Combating "afterdrop" in the deep body temperature is extremely important. Warming of the trunk of the body should be the prime concern. When heat is applied to the arms and legs, it causes those blood vessels to relax allowing that cold blood to flow back into the body core further cooling the vital organs.

During their latest experiments, in conjunction with the U. S. Coast Guard, researchers determined that the best warming technique was from the inside out, by breathing moist, warmed oxygen.

The next best treatment is a hot bath with the water temperature between 100° and 115°F. If a tub is not available, an inflated liferaft could be used. If possible, the limbs should remain out of the water. When no tub-type facility is available, a hot (115°F) shower while wrapped in towels or blankets is preferable.

When hot water for a tub or shower is unavailable, wrap the victim in "warmed" blankets in a warm room with a heating pad or hot water bottle on the chest. As a last resort, apply body warmth by direct contact with a rescuer.

Warm liquids may be given, but care must be taken to insure the victim is conscious and does not breathe the liquid into his lungs. Alcohol should never be given because it causes "afterdrop." Observe the victim's respiration closely and monitor for vomiting.

For further details or information, the research team may be contacted at the University of Victoria, P. O. Box 1700, Victoria, British Columbia, Canada V8W 2Y2.

The Coast Guard's "Pocket Guide to Cold Water Survival" (CG-413) is available from Commandant (G-DST-1/62 TRPT), U.S. Coast Guard, Washington, D. C. 20590.

Mariners Weather Log

GREAT LAKES NAVIGATION SEASON, 1975

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Washington, D. C.

Question: When there is year-round navigation, when does the season start and stop? Historically, it has been when the Seaway, canals, and locks open and close; therefore, the Mariners Weather Log will still consider these events as defining the season.

Aided by a favorable outlook for weather and ice conditions, in early March, the scheduled openings for the St. Lawrence Seaway and Welland Canal were advanced from April 1 to March 25. This was the earliest start to date. Shipping through the United States Soo Locks continued year-round.

The first upbound vessel in the Seaway at Montreal was the 730-ft Canadian laker RICHLIEU on March 25. The first overseas entry to the waterway was the Yugoslavian freighter SPLIT on the 28th. Eastbound, the LAKE WINNIPEG led a group of Canadian freighters laden with grain cargoes that were stored onboard during the winter. Heavy fog slowed Seaway traffic for several days at the beginning of the season.

The Welland Canal had its shortest winter shutdown--66 days--from January 18 to March 24. The first transits of the 26-mi waterway were on March 25 by the Canadian ships H.M. GRIFFITH, upbound, and ISLAND TRANSPORT, downbound. The transits were completed in 8 to 9 hr. On April 5, the SPLIT was the first overseas vessel to pass upbound into Lake Erie. The MARJORIE LYKES (fig. 25) came up the Seaway on April 22, the first American general cargo ship into the Lakes since 1969.

The final eastbound transit of the St. Lawrence Seaway by a commercial vessel was completed, on December 21, by the Norwegian freighter IVORY NEPTUNE (fig. 26). Earlier, the ship had grounded in the lower St. Marys River, about 35 mi below the Soo, on December 11. Cargo was lightened, and the ship was freed on the 15th. On the 17th, she cleared the Welland Canal and arrived Montreal early on the 19th. Westbound Seaway traffic closed with the passage of the Canadian laker OTTERCLIFFE HALL through the Iroquois Lock on the 21st. The final closing was delayed 2 days due to fog which curtailed upbound movement.

Figure 25.--The MARJORIE LYKES while docked at Detroit.

Figure 26.--The last saltwater vessel transits Lock 7 on the St. Lawrence Seaway.

The last transits of the Welland Canal were by two Canadian freighters, the MAPLECLIFFE HALL downbound, on December 30, and the TADDOUSAC upbound early on the 31st. The cargo tonnage increased 9 percent on the Seaway and 12 percent on the Welland Canal over 1974.

The final vessel traffic through the Canadian Soo Lock was on December 12. Traffic through the American Soo Locks continued throughout the winter. There were 504 vessels from 34 countries that made 843 trips through the Seaway.

All the lake levels were considerably above the 1900-75 average except Lake Ontario. Lake Ontario was slightly below the average for the months of August and September. During January, February, and March, Lake Superior set new records. During September and October, Lake Erie was only slightly below its 1973 record for those months.

The annual average precipitation for 1975 for the Great Lakes Basin was 34.62 in, or about 10 percent above the 31.58-in normal. All lakes were above normal, from about 1 percent for Lake Superior to 15 percent for Lake Erie. Table 6 shows the average annual precipitation for each lake and the whole basin with this year's departure.

Table 6.--Annual precipitation data for 1972-75

	Great Lakes	Lake Ontario	Lake Erie	Lake Huron	Lake Michigan	Lake Superior
1972 (in)	35.97	43.67	39.70	35.32	34.97	32.22
1973 (in)	33.87	38.16	37.01	33.34	33.98	30.84
1974 (in)	28.94	33.42	34.14	25.92	32.77	23.86
1975 (in)	34.62	38.53	38.95	34.58	35.74	29.81
1975 departure (in)	+3.04	+4.14	+5.05	+3.24	+4.38	+0.17

NOAA NATIONAL WEATHER SERVICE AIDS

Weather services were provided to Great Lakes shippers throughout the 1975 season--the first year-round navigation season ever on the Lakes. National Weather Service Forecast Offices in Chicago, Detroit, Cleveland, and Buffalo served as focal points for marine services. They were supplemented by 15 other Weather Service offices in various Great Lakes states. Marine radio stations at Chicago, Buffalo, Rogers City, and a network of stations based in Lorain, Ohio, broadcast marine forecasts (MAFORs) every 6 hr and warning messages. The Lorain network and WLC in Rogers City also broadcast the LAWEB (Lakes Weather Bulletin), and several U. S. Coast Guard stations broadcast warning messages when needed.

The National Weather Service improved their own broadcast system by moving the Chicago transmitter to the Sears Building and increasing its power to 1,000 watts--more than three times its previous power. Radio facsimile was also used during the winter months on some boats. Ice and weather charts were provided through this system under the Winter Navigation Demonstration Program. The radio facsimile system was operated as a joint program between the Weather Service, U. S. Coast Guard, NASA, and the commercial broadcast stations.

Gale warnings for 1975 for the five Upper Lakes numbered 233 compared with 238 for 1974. Storm warnings numbered 43 in 1975 compared to 18 in 1974. For total warnings, this was an 8-percent increase. Data for Lake Ontario and the St. Lawrence River were not available.

ICE SEASON

An article describing the 1974-75 Great Lakes ice season by Daron E. Boyce, National Weather Service, Cleveland, Ohio, appears on page 277 of the September 1975 issue of the Mariners Weather Log.

Generally, warmer-than-normal air temperatures and a healthy U. S. economy pushed the boats of the winter run through the winter months for the first time in Great Lakes history. Year-round navigation was achieved on April 5, 1975. Ice cover was well below normal as a result of the milder weather.

Support for the winter effort was maintained from the NWS Forecast Office in Detroit and from the Ice Navigation Center in Cleveland. Observed weather and ice conditions were forwarded to the Center and redistributed to shippers.

Ten companies made plans to sail about 50 boats into January 1975. They were encouraged by the forecasts of continued mild weather during the fall.

Deep storms, typical of the months of November and December 1974, pounded the Lower Lakes with heavy snow and cold weather. Some of the heaviest snows in 100 yr fell on areas of lower Michigan and northern Ohio. Two ships were lost during the stormy period in late November and early December. The ROY A. JODREY sank in the St. Lawrence, and the JENNIFER sank off of Charlevoix, Mich.

The St. Lawrence Seaway closed on December 17, 1974, but the Welland Canal stayed open until January 17, 1975, to accommodate late-season movements of iron ore and coal. By mid-December, ice had covered many of the shallow water bays and harbors. Some shore ice also appeared in the St. Marys River and the Straits of Mackinac.

Mild temperatures continued into January which resulted in late formation of ice in many areas. The first icebreaking of the season was done in Duluth, and the first assistance to shipping was made to the G. M. HUMPHREY on January 4.

A devastating blizzard struck the Midwest on January 10 through 12. Described by some as the "blizzard of the century," it dumped 2 ft of snow on Duluth. A record low pressure was also observed as it passed through. Cold air behind the storm center reduced water temperatures in the St. Marys River to near

Figure 27.--The HENRY FORD II churns through the ice on the narrow St. Clair River.

freezing. The colder weather increased the ice thickness in shallow areas and started ice in some other sections (fig. 27). Icebreaker assistance was rendered in Green Bay. The polar icebreaker WESTWIND moved to the Straits of Mackinac on January 22. She was preceded by the MACKINAW only 2 days earlier. Meanwhile, on the Lower Lakes, the warmer weather continued.

Ice growth continued in the northern waters into February. Ice formed in Little Rapids Cut by the 8th. Other ice was pushed into the Cut as ships passed through Soo Harbor. On February 9, the ROGER BLOUGH officially set a new late-season record for navigation. Ice was 4 ft thick in Whitefish Bay as a result of windrowing. Lake Erie became ice covered in the shallower western sections, and new ice formed in southern Lake Huron. As the Huron ice moved into the River and Lake St. Clair below, jams resulted and icebreaking assistance was rendered on February 16. Brash ice in the St. Marys River below Soo Harbor reached a depth of 133 in. Milder weather during the latter days of February diminished the ice cover on Lake Superior.

A dramatic change in the weather took place, in early March, on the Lakes. After several months of warmer-than-normal weather, March temperatures were well below normal. Refreezing took place throughout the Lakes until late in the month when storms pushed some milder air northward. A major storm on March 21 resulted in a closure of the Straits of Mackinac area after the C. J. CALLAWAY sustained $100,000 in damages when she grounded near Lansing Shoals. Problems continued in the Lower Lakes with ice jams in the St. Clair River and in eastern Lake Erie near Buffalo. The warm monthend soon relieved the jams, however, and Lake Erie was nearly ice free by March 24.

On March 25, the St. Lawrence Seaway and the Welland Canal opened for navigation--the earliest ever. Another stormy period accompanied the openings with major storms striking the upper regions especially on March 25 and 28 and April 2. Many low-powered vessels were trapped for 2 to 3 days at a time in ice fields. Problems continued into April along with the cold weather. It was not until midmonth that conditions eased, and traffic flowed without assistance.

GREAT LAKES OBSERVATION PROGRAM

There were 26 vessels that participated in the weather-reporting program on the Great Lakes during the 1975 season. A total of 10,120 observations were submitted by the participating ships. This was a decrease, again this year, of 1,832 observations from 1974, and a decrease of 4,288 from 1973. The following number of observations by lake were reported: Lake Ontario, 9 by 3 ships; Lake Erie, 491 by 25 ships; Lake Huron, 2,438 by 26 ships; Lake Michigan, 1,836 by 24 ships; Lake Superior, 5,346 by 26 ships.

There were 10 days when ships reported gales (34-40 kn) on Lake Erie, 28 on Lake Huron, 31 on Lake Michigan, and 59 on Lake Superior. Strong gales (41-47 kn) were reported by ships on 6 days on Lake Huron, 3 days on Lake Michigan, and 8 days on Lake Superior. Storm winds (48-55 kn) were reported on 3 days on Lake Huron, 3 days on Lake Michigan, and 7 days on Lake Superior. Violent storm winds (56-

Figure 28.--The JOHN DYKSTRA reported the highest wind of the year, 64 kn with a gust of 70 kn.

63 kn) were reported on 2 days on Lake Huron (fig. 28). This year, December again had the most days with high-wind observations, followed by November and January. November had the most observations. Table 7 shows the high-wind observations by 10-kn categories.

Table 7.--Number of high-wind observations during calendar year 1975

High-wind categories	Observations
Over 30 kn	409
Over 40 kn	38
Over 50 kn	4

A total of 51 observations were made of seas over 12 ft. There were 40 observations of waves 13 to 15 ft, 10 of 16 to 20 ft, and 1 of 21 to 25 ft. November had both the highest number of days and observations of high waves, followed by October and January. The highest waves reported were 24.5 ft by the J. L. MAUTHE on Lake Michigan on November 30. Seas over 12 ft were reported 2 times on 2 days on Lake Erie, 8 times on 4 days on Lake Huron, 10 times on 9 days on Lake Michigan, and 30 times on 20 days on Lake Superior.

Tables 8 to 15 give summaries of the maximum winds for each lake by month, the highest wind by month on any lake, the highest 1-min wind by lake for each year since 1941, and the highest seas reported on each lake this year. The tables include only those observations that were logged and forwarded on the Great Lakes Observation Form 72-2.

NOTABLE WEATHER HAPPENINGS

INTRODUCTION

Although December had the most days and observations with high winds, November produced the highest wind, the most high-wave reports, and the highest wave. The JOHN DYKSTRA measured the highest synoptic-time wind of the year--60 kn--on Lake Huron on November 10. On that same day, at 1500, she made a special observation of 64-kn south-

Table 8. --Maximum windspeed reported on Lake Ontario for each month by National Weather Service cooperating vessels, 1975

Month	Kn	Direction	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January							
February							
March				(No observations received)			
April							
May							
June							
July	18	140°	1800	27	A. H. FERBERT	43.7	77.1
August	30	040°	0600	06	A. H. FERBERT	43.5	77.8
September	25	040°	1800	24	A. H. FERBERT	43.6	78.2
October	19	350°	1800	30	ENDERS M. VOORHEES	43.6	77.5
November	32	310°	1200	22	LEON FALK JR	43.7	78.1
December				(No observations received)			
Year	32	310°	1200	Nov. 22	LEON FALK JR	43.7	78.1

Table 9. --Maximum windspeed reported on Lake Erie for each month by National Weather Service cooperating vessels, 1975

Month	Kn	Direction	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	30	190°	1800	06	JOHN SHERWIN	41.8	82.4
February				(No observations received)			
March				(No observations received)			
April	24	190°	0600	24	EDMUND FITZGERALD	41.8	82.6
May	22	180°	1200	26	MIDDLETOWN	42.0	81.7
June	29	210°	1200	05	LEON FALK JR	41.8	82.8
July	28	310°	0600	25	ELTON HOYT II	41.6	81.7
	28	210°	1800	19	PHILIP R. CLARKE	41.7	81.9
August	27	210°	1800	21	EDMUND FITZGERALD	41.8	81.6
	27	030°	1800	06	ERNEST R. BREECH	41.9	81.4
September	38	040°	1800	24	WILLIS B. BOYER	41.8	81.8
October	40	060°	0000	19	LEON FALK JR	42.6	81.0
November	39	240°	0600	21	ELTON HOYT II	41.9	81.6
December	40	030°	1200	12	G. M. HUMPHREY	41.9	82.9
	40	040°	0600	21	FRANK ARMSTRONG	42.0	81.0
Year	40	060°	0000	Oct. 19	LEON FALK JR	42.6	81.0
	40	030°	1200	Dec. 12	G. M. HUMPHREY	41.9	82.9

Table 10. --Maximum windspeed reported on Lake Huron for each month by National Weather Service cooperating vessels, 1975

Month	Kn	Direction	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	50	250°	0600	12	EDMUND FITZGERALD	45.4	83.5
February	27	210°	0000	08	CASON J. CALLAWAY	45.8	84.4
March	20	350°	0600	02	ENDERS M. VOORHEES	45.8	84.0
April	42	270°	1200	19	EDMUND FITZGERALD	45.7	83.6
May	30	340°	0000	13	EDMUND FITZGERALD	43.5	82.4
June	29	340°	0000	08	WILLIS B. BOYER	44.7	83.1
July	56	290°	0600	25	EDMUND FITZGERALD	45.0	83.1
August	40	090°	1200	31	EDMUND FITZGERALD	45.8	83.8
September	38	310°	1800	08	JOHN DYKSTRA	45.4	83.4
	38	050°	1200	25	G. M. HUMPHREY	44.1	82.6
October	40	310°	0600	02	G. M. HUMPHREY	43.4	82.4
	40	260°	0000	16	JOHN DYKSTRA	45.8	83.7
November	60	240°	1800	10	JOHN DYKSTRA	44.5	83.2
December	45	270°	0000	01	CLIFFS VICTORY	43.5	82.3
Year	60	240°	1800	Nov. 10	JOHN DYKSTRA	44.5	83.2

Table 11.--Maximum windspeed reported on Lake Michigan for each month by National Weather Service cooperating vessels, 1975

Month	Kn	Direction	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	54	230°	1200	11	CHARLES M. WHITE	42.5	87.2
February	40	070°	0600	24	CASON J. CALLAWAY	43.0	86.4
March	35	010°	1800	02	A. H. FERBERT	45.1	86.8
	35	010°	1800	25	CASON J. CALLAWAY	44.8	86.5
April	40	260°	1800	19	ELTON HOYT II	42.3	87.5
May	31	180°	1200	14	PAUL H. CARNAHAN	45.8	85.9
June	30	250°	0600	13	ELTON HOYT II	42.4	87.4
July	38	210°	0000	19	LEON FALK JR	45.6	86.6
August	50	240°	0600	13	BENJAMIN F. FAIRLESS	45.5	86.3
September	36	340°	0000	12	CASON J. CALLAWAY	45.8	85.2
	36	200°	0600	15	ENDERS M. VOORHEES	45.7	86.0
October	41	230°	0600	03	CHARLES M. BEEGHLY	45.1	86.5
November	48	080°	1800	20	FRANK ARMSTRONG	45.8	85.5
December	40	110°	0600	13	CHARLES M. BEEGHLY	43.0	87.0
Year	54	230°	1200	Jan. 11	CHARLES M. WHITE	42.5	87.2

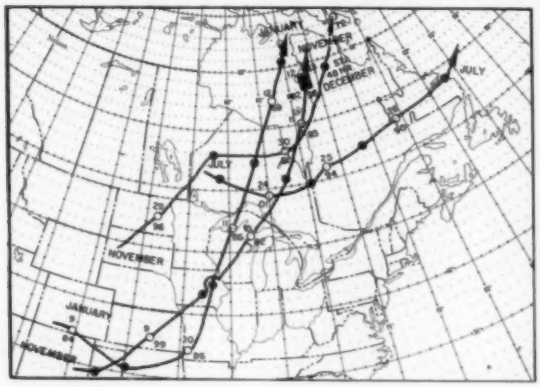


Figure 29.--Tracks of 1975 Great Lakes storms with winds greater than 50 kn or seas greater than 20 ft. Open circle indicates position of center at 1200 GMT of date shown, and closed circle indicates 0000 GMT position. Figure below open circle indicates pressure to nearest millibar.

westerlies with gusts to 70 kn and waves of 15 ft. On November 30, the FRANK ARMSTRONG noted southerly winds of 55 to 68 kn outside Indiana Harbor. The J. L. MAUTHE took the high-wave honors with 24.5 ft on Lake Michigan on November 30.

The EDMUND FITZGERALD sank in Lake Superior on November 11 during the severest storm of the year.

There were 410 synoptic observations of winds over 30 kn (405 in 1974). There were only two reports of thunderstorms at the time of observation, one during the past hour and four in past weather. There were 18 reports of squalls. May had the largest number of observations with the visibility below 2 mi with 248 or 20 percent of the total for the month. June produced 230 low-visibility observations for 18.4 percent for the month. The largest amount of ice accretion was 4-3/4 in by the G. M. HUMPHREY on November 25 on Lake Superior. There were 10 reports of ice on the Lakes entered in the remarks section. There were only two in February and none in March, even though ships ran all year.

The following paragraphs describe by month some of the more severe storms as indicated by the observations. February and March are not included because of the few boats operating and the lack of a significant number of observations. Figure 29 shows the tracks of the more intense storms.

JANUARY

This storm formed over Utah, on the 9th, and moved over Oklahoma and into Missouri, on the 10th, from where it moved almost due north. By 1800, the A. H. FERBERT was braving 40-kn southeasterlies on Lake Michigan. The LOW crossed Lake Superior near Duluth early on the 11th, setting a new record low pressure for the State of 966.8 mb. One to 2 ft of new snow was measured with drifts to 20 ft. In Minnesota it was named "storm of the century."

At 1200 on the 11th, the CHARLES M. WHITE measured 54-kn winds from the southwest on Lake Michigan with 12-ft waves. Earlier at 0600, the MIDDLETOWN measured 50-kn winds on Lake Superior and 12-ft waves. By midday on the 12th, the storm was over Hudson Bay, but its circulation still extended south of the Lakes. The EDMUND FITZGERALD reported 50-kn winds on Lake Huron. The ASHLAND fought 44-kn winds on Lake Superior. The highest waves were 15 ft reported by the MIDDLETOWN on Lake Superior on the 12th.

A low center that tracked east-southeastward out of Canada crossed Lake Superior on the 18th. At 0600, the MIDDLETOWN found 40-kn gales on Lake Superior. The PHILIP R. CLARKE was battered by 13-ft seas that shifted from southwest, on the 18th, to northerly, on the 19th, on Lake Huron. On the 19th, the storm moved eastward to make way for a new storm on the 21st.

This storm followed in the path of the last one. It moved across upper Michigan on the 21st. At 0000,

Table 12.--Maximum windspeed reported on Lake Superior for each month by National Weather Service cooperating vessels, 1975

Month	Kn	Direction	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	50	250°	0600	11	MIDDLETOWN	47.3	89.7
February	38	320°	0600	08	PHILIP R. CLARKE	47.7	89.5
March	40	310°	0000	13	ENDERS M. VOORHEES	47.3	87.1
April	38	100°	1800	23	JOHN DKYSTRA	47.2	86.6
May	38	200°	0600	14	EDMUND FITZGERALD	47.3	89.5
June	36	250°	0600	16	ARMCO	47.0	85.6
July	48	300°	1800	25	EDMUND FITZGERALD	46.6	84.6
August	35	210°	0600	09	ERNEST R. BREECH	46.7	85.8
September	40	280°	0600	04	EDMUND FITZGERALD	47.3	86.5
	40	350°	0000	08	WILLIS B. BOYER	48.1	88.4
October	46	290°	0600	06	JOHN DYKSTRA	46.8	85.0
November	50	300°	0000	11	ARTHUR M. ANDERSON	47.1	85.3
December	50	300°	0600	06	FRANK ARMSTRONG	47.5	87.3
Year	50	250°	0600	Jan. 11	MIDDLETOWN	47.3	89.7
	50	300°	0000	Nov. 11	ARTHUR M. ANDERSON	47.1	85.3

Table 13.--Maximum windspeed reported for each month for the Great Lakes by National Weather Service cooperating vessels, 1975

Month	Kn	Direction	Time (GMT)	Date	Lake	Ship	Lat. (°N)	Long. (°W)
January	54	230°	1200	11	Michigan	CHARLES M. WHITE	42.5	87.2
February	40	070°	0600	24	Michigan	CASON J. CALLAWAY	43.0	86.4
March	40	310°	0000	13	Superior	ENDERS M. VOORHEES	47.3	87.1
April	42	270°	1200	19	Huron	EDMUND FITZGERALD	45.7	83.6
May	38	200°	0600	14	Superior	EDMUND FITZGERALD	47.3	89.5
June	36	250°	0600	16	Superior	ARMCO	47.0	85.6
July	56	290°	0600	25	Huron	EDMUND FITZGERALD	45.0	83.1
August	50	240°	0600	13	Michigan	BENJAMIN F. FAIRLESS	45.5	86.3
September	40	280°	0600	04	Superior	EDMUND FITZGERALD	47.3	86.5
	40	350°	0000	08	Superior	WILLIS B. BOYER	48.1	88.4
October	46	290°	0600	06	Superior	JOHN DYKSTRA	46.8	85.0
November	60	240°	1800	10	Huron	JOHN DKYSTRA	44.5	83.2
December	50	300°	0600	06	Superior	FRANK ARMSTRONG	47.5	87.3
Year	60	240°	1800	Nov. 10	Huron	JOHN DYKSTRA	44.5	83.2

the PHILIP R. CLARKE was near Whitefish Bay with 45-kn southerly winds. By 1200, she was near the center of the lake with only 32-kn winds, but the seas were 12 ft.

APRIL

April 2, 1975, marked the first time that the Soo Locks had remained open the year-round. To mark the occasion, a storm moved along the south shore of Lake Erie on the 3d. Gale and storm warnings were posted for Lakes Erie and Ontario. Lake shore warnings were posted for all of the lakes. The worst snow storm since 1894 struck western New York. Chicago was paralyzed with up to 20 in of snow. O'Hare International Airport was closed for only the third time in its 26-yr history with 2,000 flights cancelled.

A large storm system covered the area from the Great Lakes to Texas. On the 18th, a LOW center moved rapidly from Kansas to near Chicago where it combined with another LOW early on the 19th. It crossed Lakes Michigan and Huron and by 1200 was south of James Bay. At that time, the EDMUND FITZGERALD reported 42-kn winds with squalls on Lake Huron. On Lake Michigan, the ELTON HOYT II had westerly 40-kn winds, and on Lake Superior the JOHN SHERWIN had 34-kn gales from the north. The LOW continued moving northeastward, and late on the 20th, the winds were breezes.

MAY

This was a very quiet month. It ranked third in the total number of observations for any one month with 1,201, only 71 observations less than June, which was first with 1,272. There were only six synoptic reports of winds over 30 kn. May had the greatest number of observations of visibility below 2 mi. This is also indicative of the light winds together with warm moist air over the colder water.

In the middle of the month a LOW moved southeastward from Lake Winnipeg. At 0600 on the 14th, the EDMUND FITZGERALD measured 38-kn winds on Lake Superior, the highest for the month. Six hours

Table 14.--Highest 1-min wind (kn) reported on the Great Lakes by U. S. anemometer-equipped vessels

Year	Lake Erie		Lake Huron		Lake Michigan		Lake Superior		Lake Ontario	
1941	W	42	WSW	50	NW	43	NNW	54	--	--
1942	WSW	52	WSW	56	WNW	48	S	62	--	--
1943	WSW	57	WNW	43	SSW	50	WSW	52	--	--
1944	NE	38	NW	37	WSW	48	NNE	42	--	--
1945	WNW	52	SSW	54	WNW	49	NW	52	--	--
1946	SW	50	W	46	S	44	NW	47	--	--
1947	NW	51	SSE	43	ENE	39	WSW	43	--	--
1948	WSW	40	NNW	51	NW	45	WSW	48	--	--
1949	W	52	NNE	50	NNW	43	N	52	--	--
1950	SW	70	NW	48	NW	49	NW	81[1]	--	--
1951	WSW	37	WSW	50	SW	49	WSW	54	--	--
1952	SW	46	SW	57	SSW	44	WSW	45	--	--
1953	WSW	49	NW	45	NNW	46	ENE	50	--	--
1954	W	45	NW	45	E	48	N	43	--	--
1955	W	52	SW	57	WSW	58[1]	NW	48	--	--
1956	WSW	46	W	43	SSW	46	N	50	--	--
1957	WSW	72	SW	54	WSW	49	W	47	--	--
1958	SW	61	SW	43	SW	52	SSW	54	--	--
1959	W	42	NE	50	E	48	W	54	--	--
1960	NE	55	WSW	49	NW	55	N	54	--	--
1961	W	50	NW	47	NW	48	N	57	--	--
1962	NW	52	WNW	63	NW	48	NNW	60	--	--
1963	NNW	74[1]	NW	60	N	52	NNW	52	E	35
1964	WSW	68	W	72	NW	54	WSW	62	WNW	50[1]
1965	WSW	60	WNW	95[1]	ESE	52	SW	70	W	40
1966	ENE	49	NE	60	NW	57	NNE	61	W	39
1967	WSW	43	W	58	ENE	55	N	53	W	32
1968	W	63	NNW	44	WNW	46	NNE	55	SW	31
1969	WSW	44	NNW	46	NW	50	SSW	50	--	--
1970	W	52	W	62	NW	52	W	63	--	--
1971	SW	50	N	53	N	50	SW	56	--	--
1972	W	45	NW	56	N	54	NNE	60	--	--
1973	SW	45	ENE	44	NE	56	NE	50	--	--
1974	ENE	48	SW	47	SW	42	ESE	46	W	38
1975	NE	40	WSW	60	SW	54	W	50	NW	32

[1]Highest for each lake

later, the PAUL H. CARNAHAN had 31-kn gales on Lake Michigan. On the 15th, the center moved across the Lakes. The G. M. HUMPHREY found chilling 2°C north winds over Lake Superior. The storm moved eastward and was replaced by high pressure on the 16th.

On the 20th and 21st, a frontal system was north and west of Lake Superior. There were two reports of minimal gales with squalls in the area.

JUNE

There were more observations this month than any of the others--1,272. It ranked second in low-visibility reports with only five reports of winds greater than 30 kn by cooperating ships.

A LOW moved north-northeastward along the western shore of Lake Michigan on the 15th. All gale-force winds were over Lake Superior. The highest was 36 kn, at 0600 on the 16th, reported by the ARMCO. The highest seas were 10 ft with 35-kn winds reported by the PHILIP R. CLARKE at the same time. The storm continued northward to dissipate over Hudson Bay on the 18th.

JULY

July produced the second highest wind for the year measured at a synoptic time by a cooperating ship--56 kn over Lake Huron.

During the first half of the month, the atmosphere was unstable with many severe thunderstorms occurring over and near the Lakes. On the 1st, the MIDDLETOWN reported a thunderstorm during the past hour over Lake Superior. The 11th through 14th were unstable days with waterspouts being reported each day. On the 11th at noon, one was seen over the Straits of Mackinac off Brevort. On the 12th, three waterspouts occurred off Alpena, and one touched down near the waterfront. About an hour later on the Lake Michigan side, three spouts were seen by the Coast Guard south of Frankfort. Approximately 30

Table 15.--Highest seas reported on the Great Lakes by National Weather Service cooperating vessels, 1975

	Ship	Date	Height (ft)
Lake Ontario	LEON FALK JR	November 22	7
Lake Erie	J. BURTON AYERS	September 24	13
Lake Erie	ARTHUR M. ANDERSON	November 27	13
Lake Huron	J. BURTON AYERS	November 10	20
Lake Michigan	J. L. MAUTHE	November 30	25
Lake Superior	WILLIS B. BOYER	September 8	20
Lake Superior	JOHN DYKSTRA	November 12	20

min later, 2 or 3 waterspouts were spotted from an aircraft west of Manistee.

On the 13th, a waterspout was photographed in Lorain Harbor. It dissipated when it hit the beach. They shifted back to Alpena on the 14th, when two were spotted moving northeastward north of Alpena late in the afternoon.

At 0000 on the 19th, a front was over western Lake Superior. The MIDDLETOWN reported 12-ft waves on the eastern half with 30-kn winds and lightning. The LEON FALK JR measured 38-kn winds on Lake Michigan.

A storm center passed north of Lake Superior on the 24th, but the strong winds did not occur until the 25th. Half of the wind reports of over 30 kn occurred on this day. At 0000 the ERNEST R. BREECH had 39-kn gales over Whitefish Bay. The G. M. HUMPHREY had 40- and 43-kn winds on Lake Huron at 0600 and 1200. The EDMUND FITZGERALD locked upstream through the Soo with a 56-kn wind on Lake Huron off Alpena at 0600 and a 48-kn wind over Whitefish Bay at 1800. On the 26th, the area came under the influence of high pressure.

AUGUST

Michigan got off to a fast start with a waterspout reported 11 mi west of Muskegon early on the 2d. On the 5th, late in the evening, a waterspout was sighted over Lake Michigan off Evanston. The area received a break until the 25th, when another developed over Lake St. Clair late in the afternoon. Thunderstorm activity was fairly evenly dispersed throughout the month, generally with only a few days between outbreaks.

The highest wind for the month occurred on the 13th at 0600. An occluded front stretched north over Lake Superior with a warm front eastward across Lakes Michigan and Huron. The BENJAMIN F. FAIRLESS was on northern Lake Michigan with squalls and 50-kn southwesterly winds. Thunderstorms were coded in the past weather. The visibility was less than 1/4 mi.

One of the two present weather code 90's thunderstorm reports was filed by the ELTON HOYT II at 1200 on the 24th over central Lake Michigan. The wind was southwest at 37 kn.

Four wind reports of over 30 kn were made at 1800 on the 25th. The four ships were over west-central Lake Superior from 88.1° to 90.5°W. The winds were measured at 32 to 34 kn from the west-southwest. A cold front had moved eastward over that area at about 1100 that day, and the sky was mostly clear.

The last significant winds were on the last day of the month. On the 30th, a weak LOW stalled near Gary, Ind. At 1800 the J. BURTON AYERS on Lake Huron found 12-ft waves with 23-kn winds. At 1200 and 1800 on the 31st, the EDMUND FITZGERALD was traversing the same area headed northward and measured 40- and 38-kn winds, respectively.

SEPTEMBER

The number of high windspeed reports begins to increase this month as the cyclone tracks move southward and are more intense. There were two reports of 40 kn, the highest reported. The first was at 0600 on the 4th on Lake Superior by the EDMUND FITZGERALD. The wind occurred in westerly flow after the passage of a cold front. The second 40-kn report, with 20-ft waves, was at 0000 on the 8th by the WILLIS B. BOYER south of Isle Royale. This was one of the three high-wave reports of 20 ft that occurred this year. In this instance a LOW was located near Sault Ste. Marie, and the wind occurred in the northerly flow.

These winds and waves were generated in the easterly wind gradient between extratropical Eloise and a large HIGH over Ontario. At 1800 on the 24th, the WILLIS B. BOYER was near Cleveland on Lake Erie with 38-kn northeasterly winds and 8-ft waves. Just 30 min longitude west, the J. BURTON AYERS had 33-kn winds and 13-ft seas, the highest measured on Lake Erie this year. Lake shore warnings were issued for western Lake Erie. At 1200 on the 25th, the G. M. HUMPHREY on southern Lake Huron encountered 38-kn winds and 8-ft seas. There were minimal gale reports on Lake Michigan on the 25th. The HIGH split into two sections, one over the Midwest and the other over Canada, and moved eastward as the LOW disintegrated.

OCTOBER

On the 2d, a large HIGH was centered over the Iowa-Missouri border. Its circulation covered most of the United States. Hurricane Gladys was off Cape Hatteras, and an Arctic LOW was near Churchill. At 0600, the G. M. HUMPHREY was on Lake St. Clair with 40-kn northwesterly winds. At 0600 on the 3d, the CHARLES M. BEEGHLY on northern Lake Michigan was hit by 41-kn southwesterly winds, while the ERNEST T. WEIR on Lake Superior was pounded by 12-ft waves. At 1200, the J. L. MAUTHE pounded into 13-ft waves as she approached Duluth. Gale warnings were posted for Lakes Superior, Michigan, and Huron.

On the 6th, a cold front moved southward over Lake Superior. At 0600, the JOHN DYKSTRA was sailing out of Whitefish Bay when she was hit by 46-kn gales from west-northwest. Six hours later, she was sailing into 40-kn winds. All the gale-force winds were over Lake Superior, and they decreased as the front drifted southward.

A HIGH was over Lake Superior on the 17th, as a LOW moved northeastward out of the Gulf of Mexico. The HIGH was moving eastward with only a slight northerly component as the LOW moved over West Virginia on the 18th. This tightened the gradient with increasing windspeeds. At 0600, the CHARLES M. BEEGHLY on southern Lake Michigan found 38-kn gales, and the G. M. HUMPHREY on Lake St. Clair had 34-kn gales. Gale warnings with shore erosion warnings were out for lower Lakes Huron and Michigan and Lakes Erie and Ontario. Waves of 6 to 10 ft crashed ashore on southwestern Lake Michigan. Sixteen boats, up to the size of cabin cruisers, were destroyed. The PHILIP R. CLARKE measured 32-kn winds and 10-ft waves on Lake Huron. The LEON FALK JR was headed north on Lake St. Clair with 38- and 40-kn winds late on the 18th. At 1800, the waves were 12 ft. The LOW broke into two centers, on the 19th, and weakened considerably.

This low center moved out of the Oklahoma-Kansas area on the 24th. At 1200, the ELTON HOYT II encountered a squall line with the front and 32-kn winds. On the 25th, the storm had strengthened, and the center moved into Ontario. At 1200, the HOYT was eastbound on Lake Superior at virtually the same point as 24 hr earlier with 44-kn westerly winds and 18-ft waves. At 0000 on the 26th, the CHARLES M. WHITE was near the center of Lake Superior, and the winds were westerly at 36 kn. The storm was moving rapidly northeastward and out of the area.

NOVEMBER

This was the most severe month of the year, with the highest wind and wave and more high wave reports than the other months, even though December had more total high reports. The sinking of the EDMUND FITZGERALD also contributed to this distinction.

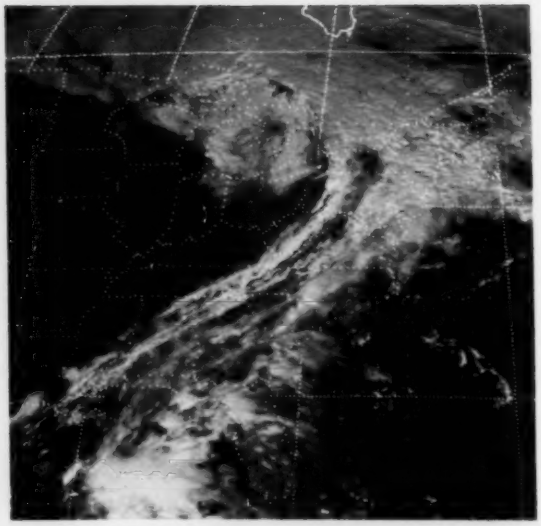


Figure 30.--SMS-1 catches the "Storm of the Year" as it crosses the Great Lakes at 1700. Note the sharp cold front trailing to the southwest.

Storm of the Year--This was the most severe storm of the year. The surface weather chart for 1200 on the 9th indicated a warm front from the lower Great Lakes west-southwestward through northern Illinois to a 1000-mb LOW in Kansas. The low-pressure disturbance intensified and increased its circulation as it progressed northeastward. At 1200 on the 10th, the central pressure had fallen to 982 mb over upper Michigan. The storm center crossed eastern Lake Superior and at 1800 was over the northeastern shore at 980 mb (fig. 30). The circulation continued to en-

Figure 31.--The EDMUND FITZGERALD on the Detroit River, May 1975.

large, and colder air was drawn southward and eastward over Lake Superior. The cold air over the relatively warmer water resulted in increased instability and stronger surface winds, especially gusts. Marquette, Mich., reported gusts to 52 kn.

Some of the stronger winds and higher waves reported by lakers, on the 10th, were as follows: On Lake Superior--CASON J. CALLAWAY, 48-kn winds and 18-ft waves; PHILIP R. CLARKE, 42 kn and 13 ft with a thunderstorm; JOHN SHERWIN, 40 kn and 12 ft; on Lake Michigan--FRANK ARMSTRONG, 40 kn and 10 ft; and on Lake Huron--JOHN DYKSTRA, 60 kn and 15 ft; MIDDLETOWN, 50 kn and 16 ft; J. BURTON AYERS, 46 kn and 20 ft. The JOHN DYKSTRA had the highest wind for the year.

At 0000 on the 11th, the EDMUND FITZGERALD (fig. 31) was approaching Whitefish Bay toward the Soo Locks with 26,216 tons of taconite ore pellets. The FITZGERALD had reported taking on water through the vents, but the pumps were taking care of it. At 0025, the ARTHUR M. ANDERSON, which was about 10 min behind, reported that all communication and radar contact with the FITZGERALD had been lost approximately 15 min earlier--1910 local time on the 10th. At 0000 on the 11th, the ARTHUR M. ANDERSON measured 50-kn winds from 300° and 16-ft waves. On upper Lake Huron, the JOHN DYKSTRA reported 54-kn winds and 15-ft waves. Gusts as high as 75 kn and waves up to 25 ft were reported to have occurred. The air temperature was 41°F, and the water temperature was 49°F.

The FITZGERALD was 729 ft long and sank in 520 ft of water about 43 mi northwest of Sault Ste. Marie with the loss of all 29 crew members. The LOW continued northeastward and, at 1200 on the 11th, was centered over James Bay. By morning, the gradient over the Lakes had weakened considerably, but low clouds restricted search and rescue operations.

This storm also caused highly shifted lake levels on Lake Erie. At about 1830 on the 10th, Lake Erie's water level at Buffalo was almost 13 ft higher than at Toledo. The water level at Toledo dropped nearly 6 ft from calm level, while at Buffalo the level rose almost 7 ft.

On November 12, another storm moved south of Lake Superior. Its chief claim to fame was 48-kn northeasterly winds and 20-ft waves on western Lake Superior as measured by the JOHN DYKSTRA at 1200. On the 13th, the JOHN SHERWIN and ARTHUR M. ANDERSON both reported winds as high as 40 kn with the latter reporting 16-ft waves on Lake Michigan.

This storm approached the Lakes from the same general direction and area as the storm on the 10th. The first significant wind by a cooperating ship was 48 kn over Lake Michigan, at 1800 on the 20th, by the FRANK ARMSTRONG. At that time, the storm was centered over Iowa. The storm moved northeastward over upper Lake Michigan. The storm had already weakened with only gale-force winds on the 21st. As the center moved east of Lake Huron, the northerly flow brought a tighter gradient and stronger winds. Several ships reported winds in the 30-kn category over Lakes Huron, Michigan, and Superior on the 22d. As high pressure moved in, the winds decreased.

A low center traveled from near Winnipeg to James Bay on the 30th. A strong cold front trailed southward from the LOW. Gales of 38 kn were reported by the JOHN SHERWIN on Lake Michigan and the CHARLES M. WHITE on Lake Superior, on the 29th, in the southeasterly flow ahead of the front. On the 30th, gales were reported over all the Lakes. The J. L. MAUTHE had 45-kn winds and 24.5-ft waves, at 0600, about 15 mi west of Holland, Mich. The front moved across the Lakes late on the 30th and early on December 1. The highest winds were over Lake Huron, early on the 1st, as the CLIFFS VICTORY recorded 45-kn westerly winds. The winds continued at gale force, up to 38 kn on Lake Erie, through the 2d.

DECEMBER

This storm tracked north of the Lakes but made itself felt to the south. The storm came from the Pacific and reformed over and east of the Rocky Mountains, passing over Lake Winnipeg into Hudson Bay on the 6th. On the 5th, gales were reported on Lakes Erie and Superior. Many gale reports were logged on the 6th on all the Lakes. The highest was 50 kn, at 0600, on Lake Superior by the FRANK ARMSTRONG. The waves were 15 ft. The CLIFFS VICTORY was sailing into 39-kn winds on Lake Huron, and the LEON FALK JR was headed into 35-kn gales on Lake Michigan. On the 7th, a HIGH moved over the area.

These winds were associated with the southeasterly circulation below a HIGH moving over Ontario. At 1200 on the 12th, the G. M. HUMPHREY contended with 40-kn gales over western Lake Erie. On the 13th, the CASON J. CALLAWAY had 48-kn storm winds on central Lake Superior. On Lake Michigan the CHARLES M. BEEGHLY braved 40-kn winds near Milwaukee. On the 14th, a LOW developed near International Falls resulting in lighter winds.

The remainder of the month and year was relatively quiet as far as reporting ships were concerned. This could partially be because of the decreasing number of ships in operation with a resulting decrease in observations.

ACKNOWLEDGEMENTS

The first expression of appreciation must go to the masters and mates aboard the cooperating vessels for their valuable observations and contributions to the National Weather Service observing program. Much useful information and photographs were obtained through the courtesy of Albert G. Ballert and the Great Lakes Newsletter of the Great Lakes Commission. National Weather Service meteorological and ice data were provided by Daron E. Boyce of the Ice Navigation Center.

Of primary importance were the listings of wind, wave, visibility, and ice data by the Environmental Data Service's National Climatic Center in Asheville, N. C., on which much of the information in the article is based.

Hints to the Observer

HURRICANE REPORTING

Dear Captain:

I'd like to remind you that the hurricane season (June through November) is near. In order for us to provide adequate warnings, it is essential that we receive as much information as possible from ships encountering evidence of hurricanes.

To assist our forecasters in determining storm location, intensity, and movement, we would like you to:

1. Make and transmit reports at least at 3-hr intervals when within 300 mi of a tropical storm or hurricane.

2. Include in "Remarks" the lowest pressure and/or the highest wind encountered if, since the last synoptic report:

   a. The pressure was more than 5 mb lower, and/or

   b. The wind was more than 15 kn higher than the present value(s).

   Also, include the time of occurrence.

   Example: 0800Z LOWEST PRESSURE 970MB 0730Z HIGHEST WIND 85KN.

I've enclosed copies of "General Instructions for Radio Reporting of Weather Observations" for your use.

The National Weather Service appreciates the time and effort you and your officers give to provide reports of weather conditions at sea. Your reports are extremely important considering the vast ocean spaces and the relatively few ships that report weather.

Sincerely,

George P. Cressman

George P. Cressman
Director, National Weather Service

GENERAL INSTRUCTIONS FOR RADIO REPORTING OF WEATHER OBSERVATIONS

Standard Synoptic Observation Times -- The regular weather-reporting hours are 0000, 0600, 1200, and 1800 GMT. Occasionally, watch schedules or priority of other duties make it impractical to make and transmit surface observations at standard synoptic times. To ensure message transmission, observations may be made in advance of the weather-reporting hours. In these cases, the actual time of observation should be included in the report.

Coded Weather Messages--All messages to be transmitted by radio should be transcribed from the ship's weather log to NOAA Form 72-4, "Weather Report for Immediate Radio Transmission," in the ship synoptic code FM21E and given to the Radio Officer.

Transmission of Radio Messages--Weather messages should be transmitted as soon as possible to the most convenient radio station in accordance with instructions contained in United States and Foreign Coastal Radio Stations Accepting Ships' Weather Observation Messages.

If a message cannot be transmitted within 3 hr after a standard time, no further attempt should be made unless the observation was made in the Southern Hemisphere or reflects severe weather conditions not included in the latest forecasts. Observations delayed more than 12 hr should not be transmitted in any case.

Worldwide Weather Reporting--You are urged to contribute to this World Meteorological Organization (WMO) program by transmitting weather reports to national meteorological services responsible for collecting ship observations in all parts of the world. Addresses for transmissions are contained in United States and Foreign Coastal Radio Stations Accepting Ships' Weather Observation Messages.

Weather Message Addresses for Transmission to U.S. Radio Stations--Use "OBS METEO WASHDC" when in the:

1. Western North Atlantic, including the Gulf of Mexico and Caribbean Sea, north of 3°N latitude, and west of 35°W longitude (WMO Region IV-A).
2. Eastern North Pacific (north of the Equator), east of the 180th meridian (WMO Region IV-A).
3. Eastern South Pacific (south of the Equator), from the South American coast to 120°W longitude (WMO Region III-B).

Use "OBS METEO GUAM" when in the western North Pacific between 5° and 25°N latitude, and from 135°E to the 180th meridian (WMO GUAM ZONE).

Observations During Storm Conditions--Whenever TROPICAL STORM, TYPHOON, or HURRICANE conditions are encountered anywhere, "SAFETY OF LIFE AT SEA CONVENTION," Chapter V, requires all ships to take a special observation and transmit the report to the closest national meteorological service via the most convenient radio station. In addition to this requirement, it is highly desirable that weather reports be transmitted hourly if possible, but, in any case, not less frequently than every 3 hr.

Special Requests for Observations--During storm situations, the U. S. National Weather Service may request ships located in areas of suspected storm development to take special observations at more frequent intervals than the routine 6-hr synoptic observation times. If your ship happens to be in such an area, your report will be helpful even though conditions may not appear bad enough to warrant a special observation. To speed delivery of messages from storm areas and to identify them as such, the word STORM should appear immediately following the radio address. These messages should be addressed to the requesting forecast office. For example, "OBS METEO NEW YORK STORM 99305 70750," etc., would be used if the New York Forecast Office requested the observation.

Observations in Coastal Waters--Since radio weather reports are always needed from ships in coastal waters, observations should continue to be taken as close to shore as ship routine permits.

Tips to the Radio Officer

Thomas Reppert
National Weather Service, NOAA
Silver Spring, Md.

Mr. Warren D. Hight, who for many years conducted this column, has retired. We in the Marine Weather Service will miss him as will his many friends afloat. Best of luck in your retirement, Warren!

The new edition of "Worldwide Marine Weather Broadcasts" became available in early April and is now being distributed. Users will find some minor printing errors in the new edition which should not affect the overall usefulness of the book. Corrections will continue to be published in this column as usual.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS, 1975 EDITION

Page 6--Halifax, Nova Scotia (CFH): Column 4, delete 4356.5, 6449.5, 8662, 12984, 17218.4. Insert 4255, 6430, 8697, 12990, 16926.5.
Norfolk, Va. (NAM): Delete Area b. Correct times 0400, 0600, 1830, to read 0500, 0630, 1900. Delete frequencies 88, 134.9. Delete Footnote 1.

Page 16--Pt. Reyes, Calif. (NMC): Area c, delete Areas 1 and 2. Add frequency 4346.
Delete all of San Francisco, Calif. (NPG).
Delete all of Norfolk, Va. (NAM), see page 6.

Page 17--Top of page should read North Pacific instead of North Atlantic.
Delete Ketchikan, Alaska (NMJ).
Kodiak, Alaska (NOJ): Add times and frequency 0530, 1730, 470 S. F Areas 1, 2.

Page 18--Honolulu, Hawaii (NMO): Delete times 0530, 2030 and insert times 0100, 0400, 0700, 2000. Delete frequencies 8650, 12889.5, 17247.2 and insert frequencies 4525, 9050, 13655, 16457.5, 22593. Delete Footnote 1. Delete "Note."
Delete all of Honolulu, Hawaii (NPM).

Page 35--Fort Collins, Colo. (WWV): Add frequencies 2500, 20000, 25000. Add in Footnote 4: "Extra slot available if needed."

Page 37--Shinnecock, N.Y., U.S.A. (NMY-41): On receipt, delete 1120 and insert 1220.

Page 38--Delete all of Baltimore, Md. (WMH).

Page 39--Key West, Fla., U.S.A. (NOK): Delete time 2200 and insert 2000.
New Orleans, La., U.S.A. (NMG): Add times 1050, 1650, 2250. Add frequency 157.1 MHz(F3) F

Page 40--Add new station.
2-0445
Grand Isle, La., U.S.A. (NMG-15)
Area: Coastal waters - Biloxi, Miss., to Morgan City, La.
Times: 1045 1645 2245
Frequency: 157.1 MHz(F3) F

Page 40--Add new station.
2-0475
Port Aransas, Tex., U.S.A. (NOY-3)
Area: Port Arthur, Tex., to Brownsville, Tex.
Times: 1040 1645 2245
Frequency: 157.1 MHz(F3) F

Page 47--Fort Collins, Colo. (WWV): Add frequencies 2500, 20000, 25000.
San Francisco, Calif., U.S.A. (KMI): Delete all times and frequencies. Insert times 0000, 0600, 1500. Insert frequencies 4371, 8738.4, 8735.2, 13161.5, 17307.5 (A3A). Delete footnotes 2, 4.
Delete all of Nome, Alaska (KC194).

Page 48--Yakutat, Alaska, U.S.A. (KGD91): Delete time 2300 and insert 1800 and 2000.
Juneau, Alaska, U.S.A. (KC197): Delete time 2125 and insert 2325.

Page 50--Portland, Oreg., U.S.A. (KQX): Transmits Warnings instead of Forecasts; change "F" to "W."

CORRECTIONS TO PUBLICATION, RADIOSTATIONS ACCEPTING SHIPS' WEATHER OBSERVATIONS

As of June 5, 1976 - 0000Z.

Pages 5-7--NMF 8728 kHz will become 8459 kHz.
NMC 17218.5 kHz will become 16889.9 kHz.

NMO17247.8 kHz will become 16909.7 kHz.

Page 13--Columbo, Sri Lanka (4PM): According to the Radio Officer of SS PRESIDENT EISENHOWER (KEJP), the 8742 kHz listed frequency should be 8473 kHz.

ACKNOWLEDGEMENT OF CORRESPONDENCE

Thanks to Max Grossman, REO SS OVERSEAS JUNEAU; Edward C. Shanks, Chief REO, SS TILLIE LYKES; Alphonse S. Goudy, Jr., RO, SS PRESIDENT EISENHOWER; and Radio Officer of the CARIBBEAN ENDEAVOR for recent information concerning the Marine Weather Program.

Hurricane Alley

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

January and February were active months in the Southern Hemisphere. While the total of ten tropical cyclones was a little below normal, the fact that six reached hurricane strength was unusual. The storm tracks and summaries are based on information provided by the National Environmental Satellite Service, warnings from the Navy's Fleet Weather Central at Guam, and tropical analysis charts from the National Meteorological Center. The information for tropical cyclone David was provided by the Australian Bureau of Meteorology, in particular, Mr. J. V. Maher.

Tracks for the January and February 1976 tropical cyclones are shown in figure 32.

SOUTH INDIAN OCEAN - JANUARY AND FEBRUARY

A hurricane and a tropical storm roamed these seas in January. February was quiet.

Terry was a severe hurricane. While christened Terry by Australia, the name Danae was probably used by Reunion. This storm thus becomes the first tropical cyclone of mixed sex. Terry reached hurricane strength on about the 14th. Maximum winds near his center fluctuated between 60 and 70 kn for several days. Then the hurricane began intensifying on the 17th. Winds climbed to 90 kn. By the 20th, they were up to 110 kn. On the 21st (fig. 33), they peaked at about 130 kn as Terry's center approached the northeast coast of Madagascar. Gales extended out 300 mi. The superstorm banged across that coast late on the 21st. The trip over rugged terrain took its toll, and Terry soon dropped back to tropical storm strength. Majunga, just northeast of the center, reported a 35-kn wind at 0000 on the 23d. As Terry moved across the Mozambique Channel, the MACOMA ran into 30-kn winds in 12-ft seas some 150 mi southwest of his

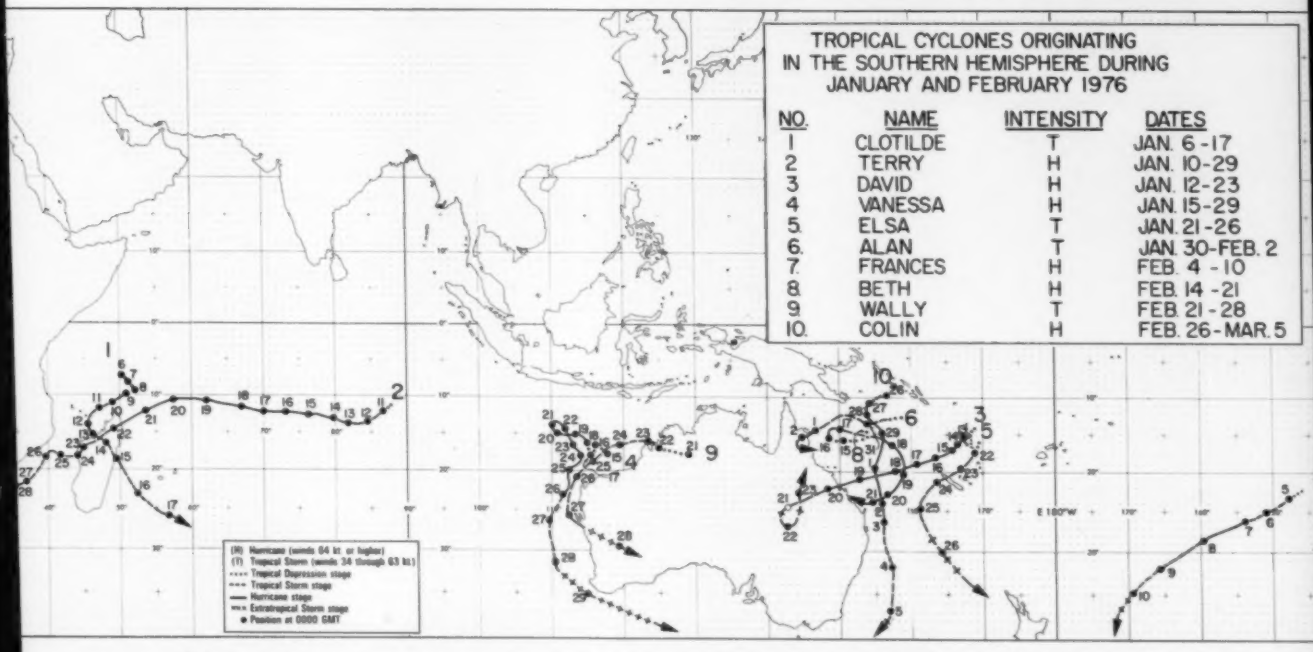


Figure 32.--Tracks of January and February 1976 tropical cyclones.

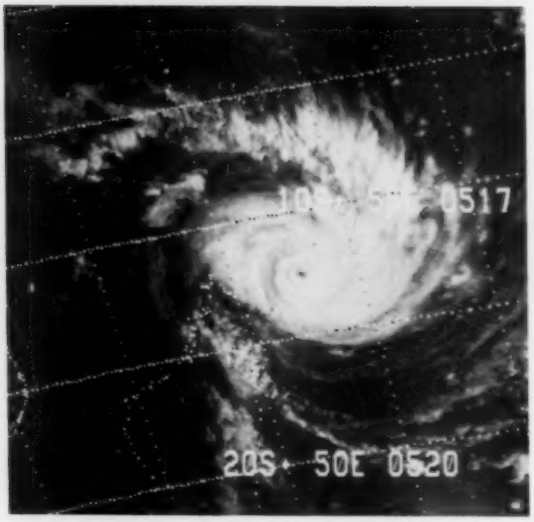


Figure 33.--Terry-Danae: This hermaphroditic hurricane is at peak intensity on the 21st.

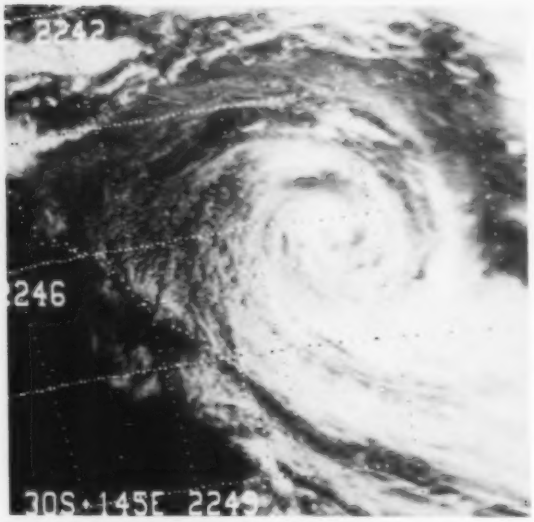


Figure 34.--Pine Islet and Lady Elliot Island, along the northeast Australian coast, are near the edge of David's large circulation as seen by satellite, but still reported gales.

center. On the 29th, the weakening storm crossed the Mozambique coast between Beira and Inhambane.

Tropical storm Clotilde had developed on the 6th. She moved southwestward toward the Mozambique Channel but recurved southeastward near the Comoro Islands. Her winds reached a peak of about 55 kn on the 12th. The following day she moved over Madagascar near Majunga, which reported a 40-kn northwesterly wind at 0000 on the 14th. She made it back over water, on the 15th, but never reintensified.

SOUTH PACIFIC-AUSTRALIA REGION JANUARY AND FEBRUARY

These waters saw two hurricanes in January and three in February, while two tropical storms developed in each month.

The first and worst was David. He was detected meandering through the New Hebrides Islands on about the 12th. While climatology dictated a south or southeasterly track, David would have none of it. His course was southwestward, and it remained between southwest and west until landfall over Australia. Movement and development were slow. David reached tropical storm strength on the 14th and hurricane intensity by the 16th. He was a big storm. Early on the 17th, a ship more than 200 mi to the north of his center encountered 15-ft seas and 21-ft swells in a stiff 40-kn gale. Also, far to the west and southwest, Pine Islet and Lady Elliot Island were reporting 30- to 40-kn winds (fig. 34). David's central pressure dropped to 960 mb, on the 18th, when maximum winds were estimated at about 85 kn with gusts to 100 kn. The YAEKAWA MARU ran into 15-ft swells and 40-kn southwesterlies more than 200 mi northwest of the center. David's intensity dropped briefly, early on the 19th, but he regained it again approaching the central Queensland coast. This was attested to by Pine Islet, which reported a 95-kn wind with a 965-mb pressure at 1200 on the 19th. A few hours later David was moving ashore across Shoalwater Bay, about 65 mi northeast of Rockhampton. Yeppoon, 55 mi to the south of the center, reported gusts up to 108 kn. The coast, particularly to the south, was ravaged. While winds unroofed houses and buildings and knocked down powerlines, the sea caused much of the estimated $6 million (Australian) damage. Beaches were severely eroded, landing jetties and seawalls were destroyed, and several boats were sunk. The $4 million, 4-yr-old Rosslyn Bay Harbor, near Yeppoon, suffered nearly total damage as thundering waves pounded through its protective seawall. So far no deaths have been reported. The storm lasted for several more days, and its heavy rains brought flooding to central Queensland.

While David was making his way toward the northeast coast of Australia, Vanessa was coming to life off the northwest coast. She formed on the 15th and lasted for 2 weeks. She was a hurricane from about the 22d through the 27th, reaching a peak on about the 25th, when winds near her center were estimated at 100 kn. On the 24th and 25th, the KANSK, along with several other ships, reported 50-kn winds in seas ranging from about 15 to 25 ft. All were within 60 mi of the storm's center. The SHROPSHIRE encountered 45-kn southerlies about 120 mi south of the center a day later. Van's extratropical nature became apparent on the 28th when the GMGY reported 40-kn winds in 15-ft seas and 27-ft swells some 300 mi northwest of her center. She raked Cape Leeuwin with gales as she passed nearby on the 29th.

On the 21st Elsa became the second tropical cyclone of the month to form in the New Hebrides. She moved on a more normal path than David, recurving through the Coral Sea. As a tropical storm, she reached a peak on about the 24th and 25th when winds near her center were estimated at 55 to 60 kn. Ship

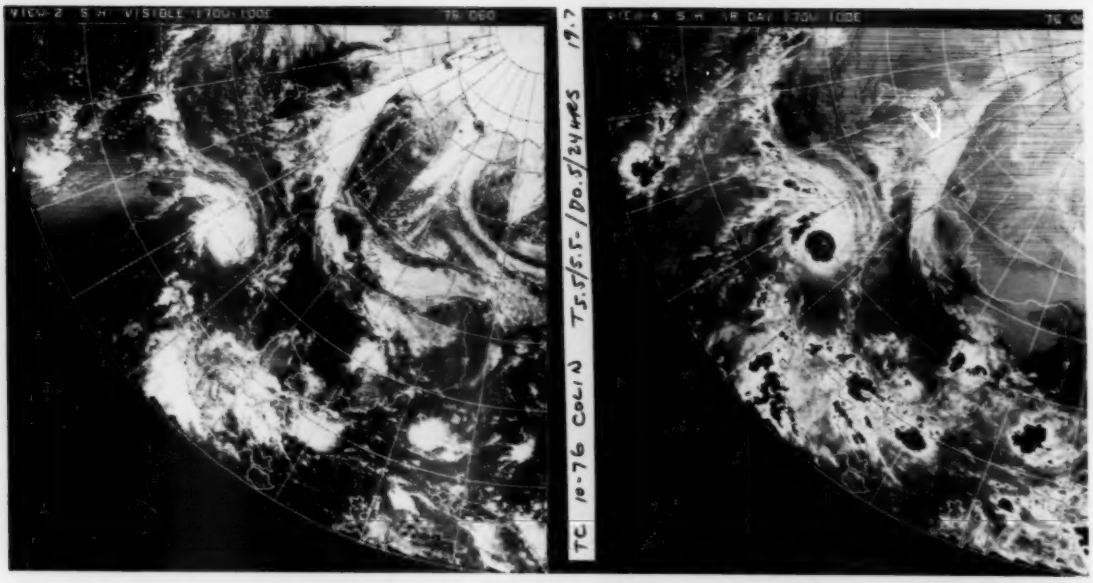


Figure 35.--Colin is viewed by regular and infrared cameras. The infrared view is enhanced by computer so that the strongest return is blacked out.

reports from 100 to 200 mi out were in the minimum gale force range. Typical was the HOZUI MARU, which encountered 35-kn winds in 10-ft seas some 100 mi north-northwest of the center. The strongest winds were reported by Cape Reinga, New Zealand, on the 26th. At 623 ft, the Cape measured 50-kn winds while the now extratropical storm was still 150 mi to the northwest.

Frances developed near the known outer limits of South Pacific tropical cyclone activity. She proceeded on an unusual prolonged southwestward journey. She was a hurricane during February 6 and 7. Maximum winds near her center were estimated at 80 kn. Tubuai Island reported a 35-kn wind at 0000 on the 6th, when Frances was 120 mi away. The storm finally began to turn southward and lost her tropical characteristics on the 10th.

Beth was a Coral Sea storm from start to finish. On the 17th, a ship, 60 mi to the north of her center, encountered 50-kn west-northwesterlies in 20-ft swells while a closer ship reported 50-kn winds with a 982-mb pressure. Soon after, Beth was upgraded to hurricane status. By the 18th, ships were reporting gales out to 200 mi. Maximum winds were estimated at about 70 kn on the 17th and 18th. On the 20th and 21st, as a degenerating tropical storm, Beth brushed Lady Elliot Island with 30- to 40-kn winds.

Wally was another unusual storm. He formed over the Sandy Desert of Northern Australia. He did not reach tropical storm strength until he moved off the coast near Cape Leveque. A Japanese ship, the JCPF, encountered 40-kn winds in 24-ft seas with a 992-mb pressure just west of Wally's center early on the 24th. On the 26th, Wally passed within 100 mi of Onslow, which reported 45-kn winds at the 0000 observation time. Maximum winds near Wally's center reached 60 kn on the 25th and 26th. The following day he moved inland south of Hamelin Pool.

Toward the end of the month, Colin formed near the Solomon Islands. He took a southward track through the Coral Sea. Colin was at hurricane intensity from about the 28th through March 2 (fig. 35). On the 28th and 29th, the ROKKOHSAN MARU, a 46,434-ton Japanese bulk carrier, battled 40- to 55-kn winds in 20- to 30-ft seas as she passed to the east and northeast of the center. Another ship, the GOEV, reported 70-kn winds on March 1. Two days later, the NORMAN LADY ran into 50-kn winds and 15-ft seas about 100 mi east-southeast of the center. Lord Howe Island came in with a 45-kn wind with the storm center some 200 mi to the northwest on the 3d.

On the Editor's Desk

NEW YORK PMO TELEPHONE NUMBER

The telephone number for the Port Meteorological Officer in New York, N.Y., has been changed to: 212-399-5569.

NOAA SCIENTIST REPORTS ON SLIDE-RULE SIMPLE MODEL OF HURRICANE WAVES

A NOAA scientist has found unexpected order in the legendary chaos of hurricane seas and has applied this to developing a model that predicts a storm's worst waves.

The model, described by NOAA oceanographer Duncan Ross at the American Meteorological Society meeting in Seattle, was developed from three violent hurricanes: Ava, the 1974 eastern Pacific storm that is still the most intense on record; Camille, the destructive 1969 Atlantic hurricane considered a "worst case"; and Eloise, the hurricane which struck the Gulf coast of northern Florida last year.

The model is one of the first to be based on actual observations taken in hurricanes. Although it is not as detailed as some models, the oceanographer believes it can specify wave heights in any quadrant of a hurricane where winds are 40 kn or greater and the storm is over deep water. This simplified model can be applied with a slide rule.

NOAA aircraft flights into Ava brought back data which indicated a relationship between maximum waves and the distance from the eye of the hurricane. The character of the waves agreed with data obtained during a high-wave experiment in the North Sea, and from other studies emphasizing the role of fetch--the distance wind travels over water. The main difference was that in a hurricane fetch becomes related to the distance from the eye.

To confirm the relationship suggested by Ava data, Ross went to wave records of hurricane Camille as that storm passed two offshore oil rigs in the Gulf of Mexico. The relationship applied to both storms, and the simple model was constructed.

The model predicts the wave energy spectrum of the storm. From this specturm one can get the highest expected wave out of a thousand waves, and the statistics of progressively smaller waves, giving a reasonable picture of the wave spectrum for most hurricanes. Some additional testing and development to account for the forward velocity of a storm different from that which went into the development of the model are still needed.

The storm which helped develop the model also revised some conventional views of hurricane waves. For example, people who have been through a storm talk about waves coming from all directions, even though the wind is from a single direction. That is true to a limited degree in fast-moving storms, but for storms with average or slower forward speeds, the waves move mostly in the direction of the wind.

It also appears that wave height may be tied to the storm's forward velocity. It was thought that slower

Figure 36.--The wave setup contributed to the storm surge of Camille which resulted in this debris near Bay St. Louis, Miss. Wide World Photo.

storms had smaller waves, but in Eloise, which initially moved more slowly than Ava or Camille, the modeled waves were somewhat smaller than the actual wave heights measured by NOAA buoys along the storm track. Evidently, the slower the storm, the bigger the waves. Eloise also verified the treatment of the winds measured at aircraft altitude to derive the average wind near the surface.

The wave model should find applications among hurricane forecasters. For example, some scientists believe a large part of the flooding caused by hurricane Eloise came from wave setup --the gradual buildup of water level as successive waves break over one another. To predict this effect, one must be able to predict the wave fields generated by hurricanes (fig. 36).

The model also has applications in designing offshore platforms and other structures subject to hurricane wave action. "Hindcasts" have been made with the model that compare favorably with waves measured for Camille (maximum significant wave height of 47 ft, or 14 m), an intense 1915 Atlantic hurricane (more than 50 ft, or 15 m), and Eloise (37 ft, or 11 m). "Significant wave height" refers to the dominant wave one sees when looking at a field of waves on the ocean.

ESSA-8 WEATHER SATELLITE TURNED OFF AFTER SEVEN YEARS

One of the first operational satellites to provide automatic picture transmission from outer space to the Earth's surface, used by more than 120 nations for meteorological data, was shut down March 12, 1976, after its camera failed.

The ESSA-8 spacecraft, launched into a sun-synchronous polar orbit for NOAA by NASA on December 15, 1968, had completed almost 33,200 orbits when the shutter of its backup camera failed to operate. The satellite's primary camera had stopped operating late in 1974.

Built for the Commerce Department by RCA, ESSA-8 provided daytime global picture coverage of the entire surface of the Earth from 900 mi (1,440 km) in space.

During a 24-hr period, the satellite transmitted between 144 and 156 individual pictures.

When the spacecraft was launched, about 40 countries had equipment capable of receiving the television-type picture transmission. As the value of the data became more broadly recognized, increasing numbers of nations built receivers, using the pictures largely for weather forecasting, but also for a wide variety of other purposes where meteorological data were necessary.

The National Environmental Satellite Service which operates the spacecraft, has for the last several years encouraged ESSA-8 users to convert their equipment to receive similar weather data from the NOAA-4 satellite. This newer spacecraft provides both day and night global coverage and utilizes a scanning radiometer system rather than a TV-type camera. Many users have made the conversion.

ESSA-8 pictures, in addition to being utilized by most of the governments of the world, also were received by hundreds of nongovernmental organizations and individuals, including universities, scientific groups, Boy Scout troops, and amateurs who enjoyed receiving pictures from outer space.

'ALL MARINERS, THIS IS WBH 29...'

Two times each day the following words are carried to Alaskan fisherman monitoring marine radio frequency 4136.3, "All mariners, all mariners, this is WBH 29 Kodiak with the marine weather..."

The voice is that of Peggy Dyson who has been contracted by the National Weather Service to broadcast over her single sideband radio the marine weather forecast from her home in Kodiak.

After calling an unlisted number at the Coast Guard base and recording the weather synopsis with a telecopier at 8 a.m. and 6 p.m., Peggy Dyson broadcasts the marine weather forecast for eight designated areas in Alaska from Cape Fairweather to Adak, including the Pribilof Islands and the southern portion of Bristol Bay. If fishermen miss the broadcast, they can call Peggy at her home, and she will interrupt her household routine to repeat it to them.

With a husband and two sons fishing in Alaskan waters, Peggy Dyson is aware of the significant role weather plays in a fisherman's life. Weather can be a matter of life and death for them. Peggy originally got her marine radio about five years ago so she could talk to her husband Oscar Dyson, skipper and owner of the PEGGY JO, and give him the weather forecast.

All fishermen's wives experience anxiety. The weather is very severe, especially in the winter months with chill factors and icing conditions.

Whenever Peggy is home, she listens to the radio. A lot of the fishermen know she stands by, and they will call her for all kinds of things besides the most recent weather report. She has ordered engine parts and relayed messages to the Coast Guard. In 1973 she heard a mayday and took the vessel's name and location and relayed the message to the Coast Guard.

NOAA OPENS TIDE MONITORING STATION ON CHESAPEAKE BAY BRIDGE TUNNEL

An automatic tide recording station, installed on the Chesapeake Bay Bridge Tunnel to serve as a research and development facility for improving technology involved in the measurement of tides and water levels, is now operational.

The station, on one of the most important Atlantic Coast waterways, is the result of 3 yr effort by NOAA's National Ocean Survey and the National Weather Service, the U.S. Army Corps of Engineers, and the Chesapeake Bay Bridge Tunnel Commission. It will be maintained by the Survey's Atlantic Marine Center in Norfolk, Va.

The Bay Bridge Tunnel station can operate up to 10 different types of tide gaging or scientific equipment simultaneously, providing an invaluable aid in evaluation, testing, and improvement of techniques of various equipment essential to obtaining more and better knowledge of our oceanic environment. Such tide measurements serve the needs of the mariner, the engineer, the scientist, and the general public.

The station's tide recorder will automatically telemeter water levels to the National Weather Service at the Norfolk Airport, providing information to aid in warning the public of rising water levels from winds

Figure 37.--A March northeaster destroyed this pier at Virginia Beach. Virginia Pilot and Ledger-Star Photo.

or heavy rains not only in the immediate area but also the Upper Bay areas where flood waters are a chronic threat to residents of low-lying sections.

Information transmitted to the U.S. Army Corps of Engineers in Norfolk will assist in the design of construction projects as well as allow additional time to establish precautionary measures during flood periods.

In addition to satisfying nautical charting requirements of the National Ocean Survey, tide measurements also:

1. Determine mean sea level and other tidal datums for surveying and engineering purposes and to establish a system of tidal bench marks to which these datums can be referred;
2. Provide data for tide predictions and publication of this data in annual tide prediction tables;
3. Investigate fluctuations of sea level and crustal movements of the Earth;
4. Supply information concerning tidal conditions for engineering projects;
5. Provide pertinent data for special estuarine studies; and
6. Determine marine boundaries, both State and Federal, for coastal zone planning and in some cases, litigation, as well as various other maritime interests.

The Bay Bridge Tunnel station, constructed on the fishing pier, replaces the Virginia Beach station which was destroyed by storms or strong winds five times in 10 yr (fig. 37). It joins a long historical list of tide observation sites for the Chesapeake Bay area, dating back to the earliest at Annapolis, Md., June 6, 1844, and Old Point Comfort, Va., July 1, 1844.

SCIENTISTS STUDY ROLE OF BACTERIA AS SEEDS OF PRECIPITATION

Oceanic bacteria may be the marine atmosphere's main source for triggering precipitation, a scientist from NOAA reported to the American Meteorological Society meeting in Seattle.

Russell Schnell of NOAA and two fellow researchers have found that these tiny marine organisms appear to act as an active source of ice nuclei--the particles around which moisture in a cloud freezes

to produce precipitation. The bacteria live in association with marine phytoplankton (minuscule floating plant life) and are "shot" into the air by seafoam bubbles bursting on the surface of the waves. Certain of them find their way high into the air and become the core, or nucleus, around which supercooled water droplets freeze. They fall to the surface of the Earth as rain or snow.

Scientists have long known that ice nuclei come from land--particles of dust and possibly decomposed vegetation. The researchers think that a major part may also come from the sea. They have isolated the particular bacterium but not yet identified it.

They analyzed 3-yr ice nucleus measurements in the Southern Hemisphere --chiefly Australia and the Antarctic Ocean--and discovered that the highest concentrations of nuclei were from areas of the ocean favorable to phytoplankton growth. The scientist who had made the measurements had been perplexed to find higher concentrations of nuclei in the air hundreds of miles at sea than over the dusty Australian interior, a finding that did not square with the belief that these nuclei came only from land-based sources.

In another study, samples of surface seawater were collected from the Pacific Ocean off North America, from the Caribbean off Nassau, and from the Atlantic at Bedford, Nova Scotia, and tested for ice nuclei. Numerous droplets from each sample were placed onto a metal plate and gradually cooled. The numbers of drops that froze at each temperature were recorded. The researchers judged that if the droplets froze at 14°F (-10°C) or warmer, the water contained effective nuclei.

They found that the samples from Bedford had a much higher concentration of nuclei than the other areas. That part of the ocean had recently experienced a "bloom" period of rapid phytoplankton growth. To see if that fact might be related to the high nucleus count, the scientists collected samples of the phytoplankton, added them to distilled water, and again tested for nuclei. The concentration was high.

At first, it was thought the phytoplankton itself might be the nucleus. To learn more about the relationship between marine phytoplankton and freezing nuclei, samples were obtained of 23 plankton species from a plankton "library" maintained at the Scripps Institution of Oceanography, mixed with distilled water, and the nucleus concentrations were measured. Dried, crushed samples of the plankton cultures were injected into a cloud chamber. Samples that contained freezing nuclei would cause particles of supercooled fog in the chamber to freeze, grow into snow crystals, and fall as in a life-size cloud. It was found that only three species of plankton contained especially high concentrations of nuclei.

The next step was to pin down what property of phytoplankton actually forms the ice nucleus--the whole or parts of phytoplankton cells, excretion products, or some organism associated with the phytoplankton, such as bacteria. Last August, samples of seawater and fog water off the east coast of Nova Scotia were collected and tested for both ice nuclei and bacteria. A number of the fog samples contained ice nuclei capable of causing freezing at temperatures warmer than 23°F (-5°C). Four out of 15 samples of bacteria isolated from the fogs were even more active, triggering freezing at temperatures above 24.8°F (-4°C). Bacteria were also isolated from one of the three species of phytoplankton from Scripps that had exhibited good nucleating ability. When tested, this bacterium was able to cause freezing at 26.6°F (-3°C).

How do these sea-going bacteria get into the atmosphere to do their job as ice nuclei? Nature has a very efficient mechanism to accomplish that. The bacteria float among plankton at or near the surface of the water. Rising bubbles collect them and upon bursting propel the nuclei into the air at speeds up to and exceeding 100 mph (160 km). It was noted that the scum that forms on nearby walls or the light bulb above a home aquarium is evidence of the same process occurring on a smaller scale.

The researchers believe this is the main way marine precipitation may begin: Bacteria from the sea act as freezing nuclei. Many people do not realize that most rain, not just snow, is initiated by an ice nucleus. Bacteria have been found inside hailstones, raindrops, and fog droplets; but their central role in possibly causing precipitation is just now being explored.

NAMES FOR TROPICAL CYCLONES, 1976

The following lists of names are those that will be assigned to tropical cyclones that reach tropical storm or greater intensity during calendar year 1976. A new list is started each calendar year for tropical cyclones of the eastern North Pacific (Central American west coast to 140°W) and of the North Atlantic, including the Caribbean Sea and the Gulf of Mexico. For the western North Pacific (140°W to the Asiatic mainland), the practice of continuing the alphabet from the previous year remains unchanged.

Atlantic	Eastern Pacific	Western Pacific	
Anna	Annette	Kathy	Kate
Belle	Bonny	Lorna	Louise
Candice	Celeste	Marie	Marge
Dottie	Diana	Nancy	Nora
Emmy	Estelle	Olga	Opal
Frances	Fernanda	Pamela	Patsy
Gloria	Gwen	Ruby	Ruth
Holly	Hyacinth	Sally	Sarah
Inga	Iva	Therese	Thelma
Jill	Joanne	Violet	Vera
Kay	Kathleen	Wilda	Wanda
Lilias	Liza	Anita	Amy
Maria	Madeline	Billie	Babe
Nola	Naomi	Clara	Carla
Orpha	Orla	Dot	Dinah
Pamela	Pauline	Ellen	Emma
Ruth	Rebecca	Fran	Freda
Shirley	Simone	Georgia	Gilda
Trixie	Tara	Hope	Harriet
Vilda	Valerie	Iris	Ivy
Wynne	Willa	Joan	Jean

PUBLICATIONS OF INTEREST TO MARINERS

PROCEEDINGS OF MARINE DATA ACQUISITION CONFERENCE

Copies of the Proceedings of the Marine Data Acquisition Conference, which was held October 21-23, 1975, at National Weather Service headquarters, are now available from the Data Systems Division (W521x2), National Weather Service, NOAA, Silver Spring, MD 20910. Telephone: 301-427-7792.

TIDE AND CURRENT GLOSSARY

This National Ocean Survey publication is an extensive revision of the 1949 Tide and Current Glossary (U.S. Coast and Geodetic Survey, Special Publication No. 228). The revision contains 61 new entries, 49 deletions, and major modifications to 63 definitions.

In addition to general terms, the Tide and Current Glossary includes those accepted definitions intrinsic to certain standard procedures of the Oceanographic Division of the National Ocean Survey.

The publication is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Price: $0.75; stock number: 003-021-00014-9.

MARINE WEATHER REVIEW

The SMOOTH LOG (complete with cyclone tracks [figs. 38-41], climatological data from U.S. Ocean Station and Buoys [tables 16 and 17], and gale and wave tables 18 and 19), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

November and December 1975

SMOOTH LOG, NOVEMBER 1975--There were many more low-pressure centers over North America, north of 40°N, than over the ocean. The primary track of the LOWs that affected North Atlantic shipping was along the east coast toward Labrador and the Labrador Sea or the Denmark Strait. A secondary track passed over the United Kingdom from the southwest. These tracks closely paralleled climatology, except the storms that formed along the U. S. East Coast formed nearer the coast than normal. The major areas of cyclogenesis were off the U. S. East Coast, east of Newfoundland, and east of the southern part of Greenland including Iceland.

The mean pressure pattern was near the climatic normal in appearance, but the pressure centers were more intense, resulting in a much tighter gradient. The 1003-mb Icelandic Low was 998 mb near 63°N, 31°W. A 1001-mb center was over the Norwegian Sea. The 1019-mb Azores High was 1025 mb near 40°N, 20°W, which was over 600 mi northeast of its normal 35°N, 31°W, location. There was a small 1015-mb Low center over Corsica in the Mediterranean Sea.

There were three major areas of pressure anomalies. A large negative area with two 6-mb centers was south and east of Kap Farvel. A positive center that dominated the eastern ocean off Europe had an 8-mb center near 47°N, 16°W. The other area was positive with 4-mb centers and covered a large area off the U. S. East Coast.

There were significant differences in the upper-air pattern at 700 mb. The trough normally over the eastern United States was over the central region. An additional trough was located over midocean with a pronounced ridge off the European West Coast.

There were no tropical cyclones this month. On the average one will occur every 3 yr and only in 1 yr in 7 will it develop to hurricane intensity.

Extratropical Cyclones--The first half of the month was relatively quiet over the North Atlantic but not over the Great Lakes. The temperate latitudes were dominated by high pressure most of the time, and when low-pressure areas developed they were generally weak and did not produce strong winds or high waves. An exception was a large area of low pressure during the 2d week, but the gradient was weak and only isolated gales were reported.

Monster of the Month--A 999-mb LOW was analyzed over Kansas on the 1200 chart of the 9th. The LOW was moving northeastward at 25 to 30 kn, deepening and expanding as it moved. At 1200 on the 10th, the

982-mb center was near Marquette, Mich., on the southern shore of Lake Superior. By 1800, the 980-mb LOWs center had crossed Lake Superior to the vicinity of 48.5°N, 85.5°W. Most shore station winds were 20 to 25 kn, but Marquette, Mich., reported gusts to 52 kn.

At 0000 on the 11th, the LOW was 978-mb pressure near 51°N, 82°W. Its cyclonic circulation stretched north-south from Hudson Bay to Detroit. The EDMUND FITZGERALD was approaching Whitefish Bay toward the locks at Sault Ste. Marie with 26,216 tons of taconite ore pellets. The ARTHUR M. ANDERSON was about 10 mi behind the FITZGERALD which had reported taking on water through the vents but the pumps were taking care of it. The last communication with the FITZGERALD was about 0000 on the 11th (1900 CST on the 10th). At 0025 the ANDERSON reported that all communication and radar contact with the FITZGERALD had been lost approximately 15 min earlier.

The winds over Lake Superior at the time were estimated at 40 to 45 kn with gusts to 75 kn and seas running 20 to 25 ft. The air temperature was 41°F and the water temperature 49°F. On the 0000 observation the ANDERSON had measured 50-kn winds from 300° and 16-ft waves. On Lake Huron the JOHN DYKSTRA measured 60-kn winds with 15-ft seas and the J. BURTON AYERS measured 46-kn winds and 20-ft waves. See the "Great Lakes Navigation Season, 1975" on page 139 of this issue.

The FITZGERALD was 729-ft long and sank in 520 ft of water about 43 mi northwest of Sault Ste. Marie with 29 crew members. None were rescued, but life saving equipment was found in the search for survivors. The ship was built in 1958. The last major ship disaster on the Great Lakes was on Nov. 29, 1966, when the DANIEL J. MORRELL broke in two during a gale on Lake Huron killing 28 crew members.

The LOW continued northeastward, and at 1200 on the 11th, the center was over the northeastern corner of James Bay. The gradient over the Lakes had weakened considerably by morning, but low clouds restricted search and rescue operations.

On the 12th, another low center moved across northern Lake Michigan and the vicious LOW stalled east of Hudson Bay to gradually fill and disappear.

The first significant storm over the open ocean formed between two large HIGHs, one over the eastern United States and the other west of the Bay of Biscay. Another LOW had developed in the same area a few days earlier and aided in the development of this LOW. At 0000 on the 18th, the 999-mb center was at 36°N, 58°W. At 1200, minimal gales were being reported, and at 0000 on the 19th, the DELTAGAS, near 33°N, 52°W, was illuminated by 45-kn winds and flashes of lightning.

As the storm moved northeastward, its circulation expanded and 35-kn gales with 10- to 15-ft waves were common reports. At 0000 on the 20th, the GEORGE WALTON was headed westward at 37.5°N, 48.5°W, with 40-kn northwesterly winds and 20-ft swells. Far to the northwest, the DART AMERICA had squalls within sight over the Grand Banks. At 1200 on the 20th, the 969-mb LOW was near 55°N, 48°W. The TEUTONIA was approximately 100 mi southeast of Kap Farvel struggling with 60-kn northeasterly storm winds at 1200 and 65-kn at 1800. The ELIZABETHPORT (37°N, 51°W) and LASH TURKIYE (39°N, 27°W) were both many miles away from the center but still were pounded by 40-kn winds. The ELIZABETHPORT had 20-ft swells and the SEA LAND CONSUMER at 39°N, 50°W, had 30-ft swells.

At 0000 on the 21st, the 960-mb surface LOW was nearly vertically alined with the upper-air LOW and rotating in a circle with its circulation. The ELBE EXPRESS, at 51°N, 45°W, was sailing into 50-kn winds and 18-ft seas. The station at Kap Farvel also measured 50 kn. At 1800, the NEW HORIZON found 47-kn winds, 16-ft seas, and 26-ft swells at 45.7°N, 44.1°W.

On the 22d, the storm broke away from the upper-air LOW and raced eastward with the zonal flow. The TROLL PARK, near 45.5°N, 33°W, was treated to 50-kn winds. As the storm approached Ireland, on the 23d, it had deteriorated to only a trough.

This storm moved out of New Mexico on the 19th. It moved on a steady great circle track until it reached the mouth of the St. Lawrence River on the 22d. At that time, the central pressure was 992 mb. As it turned northeastward, it deepened rapidly. It was 968 mb 24 hr later near 60°N, 55°W. The C. P. DISCOVERER was north of Newfoundland with 45-kn gales. On the 24th, the LOW split on the wedge of Greenland. At 1200, the main LOW redeveloped on the east coast north of Kap Farvel. The VIKTOR LYAGIN was at 52°N, 49°W, and holding her bow into 65-kn west-southwesterly winds. The seas were reported as only 13 ft. Farther east, several ships reported 35- to 45-kn winds. Ocean Weather Station "C" measured 26-ft seas, and the MOSEL EXPRESS about 100 mi to the north measured 23-ft seas. At 0000 on the 25th, CHARLIE measured 40-kn and 33-ft. At 1200, the MANCHESTER CRUSADE at 56°N, 30°W, had 50-kn winds and 16-ft seas. At 1800, the EXPORT FREEDOM (50.3°N, 21.6°W) fought 45-kn winds, 10-ft seas, and 20-ft swells.

As the LOW moved over the south coast of Iceland on the 26th, Ocean Weather Station "L" measured 45-kn winds, 16-ft seas, and 28-ft swells. Late on the 27th, the LOW turned northward as another LOW farther south raced eastward. This spelled the doom of the storm as the new LOW became the dominant system.

This LOW formed south of Cape Hatteras, late on the 23d, after the passage of a cold front. It developed

very rapidly over the warm Gulf Stream. At 0900, Ocean Weather Station Hotel measured 44-kn winds and 15-ft seas. At 1200, the EXPORT PATRIOT (37.9°N, 70.5°W) had 45-kn east-northeasterly winds, 15-ft seas, and 20-ft swells. The SANTA ISABEL (32.8°N, 75.1°W) braved 50-kn winds.

At 1200 on the 25th, the 997-mb storm was centered near 41°N, 63°W, and another small center had formed near Sydney, Nova Scotia. The LASH ESPANA logged 50-kn winds and 20-ft seas at 41.3°N, 56.5°W. Gales were common reports. By 1200 on the 26th, the new LOW had taken over control and the original LOW was only reflected as a trough.

An incipient easterly wave in the trade winds was the impetus for this storm. Earlier in the year it might have developed into a tropical cyclone. The LOW was first analyzed, on the 0000 chart of the 30th, on the strength of two ship reports. At 1200, there were more ships radioing observations, and there was no doubt of its existence. The central pressure was 1004 mb and several ships reported gales. The POST CHAMPION, near 26°N, 48°W, was about 120 mi southeast of the center (27°N, 50°W) and was plotted as 60-kn from the south. A cold front was approaching from the northwest and by 0000 on December 1 was an integral part of the storm. A British ship which could not be further identified reported 45-kn winds northwest of the center. Further north, near 42°N, 45°W, the NEW ENGLAND TRAPPER was pounded by 40-kn winds and 33-ft swells on her starboard side.

A ship whose call sign appeared to be KAZQ was within 60 mi of the 987-mb center with 55-kn winds at 1200. To the northeast the BIOKOVO reported 50-kn winds. There were reports of gales in all quadrants. The highest seas were 16 ft with the EXPORT DIPLOMAT reporting 23-ft swells at 39°N, 52°W.

On December 2, the LOW was filling and moving northwestward as a 1038-mb HIGH drifted southeastward. On the 3d, a front was moving eastward off Nova Scotia and a frontal wave formed, intensified, and absorbed the older system.

Casualties--Fog over the English Channel and Bay of Biscay resulted in two collisions on the 15th. The weather in the area was dominated by a HIGH over Spain. The 13,481-ton Zaire-registered cargo and passenger ship KANANGA and the 3,012-ton Russian fish factory YUOZAS GARYALIS collided about 20 mi off Ile D' Quessant. The KANANGA was towed to Brest. The passengers were removed by the GARYALIS and two French fishing vessels. In the Bay of Biscay a collision between a Panamanian ship and a Spanish trawler, which sank, left four of its nine crewmen missing. The 999-ton RUDOLF S. was abandoned near 45.7°N, 06.5°W, on the 16th, after the bulk cargo shifted in heavy seas and taking in water. Rescue vessels picked up 9 crew and 3 dead from dinghies. The 4,805-ton Algerian IBN ROCHD and the 8,229-ton East German LUBBENAU collided in bad visibility on the River Scheldt on the 15th.

The 16,704-ton British TACOMA CITY grounded in fog, on the 21st, in Tampa Channel. Vessel was refloated with assistance of three tugs.

Later in the month, a collision in heavy rain and poor visibility between the 28,254-ton American tanker OVERSEAS JOYCE and the 926-ton Lebanese motor vessel KARIM H left the tanker holed and aground in the Dardanelles.

On the 26th, the 4,400-ton Soviet ship GORIZONT sank after a collision with the 6,700-ton Moroccan freighter IFNI in the English Channel in poor visibility.

SMOOTH LOG, DECEMBER 1975--The centers of the LOWs that crossed the North Atlantic tended to hug the coasts. The primary track that affected shipping moved along the coast of the United States to southern Greenland and through the Denmark Strait toward northern Norway. Other major tracks were from Hudson Bay into Baffin Bay and the northeastern United States into the Davis Strait. There was an area of anomalous storm centers in midocean and off the coast of Morocco. Even though a ship may not have encountered the center of the storm, many ships experienced heavy weather many miles from the center as is usual with extratropical storms. The primary storm tracks were shifted slightly west of their climatological position.

The monthly mean sea-level pressure pattern differed greatly from the climatological mean. The Icelandic Low normally straddles Iceland with two centers of about 1000 mb, one south of the Denmark Strait and the other over the Norwegian Sea. This month the primary Low was 985 mb and centered over the Barents Sea. A secondary 1004-mb Low was over the Davis Strait. The Azores High was 1032 mb and near 50°N, 20°W, about 800 mi north-northeast of its usual 1021-mb position. The pressure over the eastern United States was slightly higher than normal. An inverted trough reflected the LOWs over the midocean.

The anomaly chart reflected the pressure differences very dramatically. There was a negative 23-mb center associated with the shifted Icelandic Low west of Novaya Zemlya. The Azores High was reflected by a positive 21-mb center near 52°N, 20°W. Another negative 9-mb center was near 30°N, 32°W, as a result of the inverted trough.

The upper-air pattern over eastern North America was near normal with a low center over Baffin Bay. The primary circulation center was over the Arctic Ocean northeast of Spitzbergen. An anomalous closed High was centered near 48°N, 24°W, resulting in a sharp southeast-oriented trough along the Labrador Coast and into the central ocean. As a consequence, the wind flow was more northerly over the western ocean north of 40°N, and more southerly over the Norwegian and North Seas. The gradient was also much tighter.

Extratropical Cyclones--The first major storm of the month developed over Lake Michigan, on the 2d, and moved offshore over Nova Scotia on the 4th. As it moved over the warmer water, gales were generated in the southwestern quadrant. At 0000 on the 5th, the 990-mb LOW was near 46°N, 53°W, and the EUROFREIGHTER was sailing into 45-kn westerlies near 42°N, 58°W. The seas were 21 ft. On the 1200 chart, the DART ATLANTIC reported 40-kn winds and 23-ft swells near 44°N, 50°W.

By 1200 on the 6th, the 993-mb LOW had raced to

64°N, 30°W. The MATHILDE SCHULTE, at 57°N, 37°W, found 45-kn winds. Late on the 6th, the storm moved over Iceland with gale-force winds. By 1200 on the 7th, the LOW had dropped to a pressure of 968 mb near 68°N, 10°E. The NORDLAND, at 62.5°N, 10°W, was fighting 65-kn hurricane-force winds with 36-ft seas and 39-ft swells. The sky was partly cloudy. The RO was north of the Shetland Islands with 50-kn winds. The LOW moved over northern Scandinavia, on the 8th, bringing high winds to coastal areas along the North Sea and Baltic Sea.

As the previous storm moved northward, on the 5th, it left an area of weak gradient (col) along the front between two large HIGHs. On the 0000 chart of the 6th, a 1008-mb LOW had formed near 34°N, 44°W. The HIGH moving off the U. S. East Coast continued moving eastward, and the gradient tightened on the west side of the LOW producing gales. By 1200, the pressure had dropped to 997 mb, and the SEA-LAND CONSUMER encountered 50-kn winds, about 140 mi southwest of the center, along with 20-ft seas and 33-ft swells. Twelve hours later, the HECTOR also fought 50-kn winds and 21-ft waves on her port side.

The LOW was quasi-stationary near 38°N, 50°W, as the HIGH to the northeast remained stationary. The East Coast HIGH moved southeastward with decreasing pressure, and a large Canadian HIGH approached from the northwest. On the 9th, gales were reported in all quadrants.

At 0000 on the 10th, the NEW ENGLAND TRAPPER and the WESER EXPRESS, both northwest of the center, had 50-kn northerly winds. The SUGAR TRANSPORTER, at 44°N, 50.1°W, was plotted as having 39-ft swells from 350°. At 1200, the BRUNSKAMP, near 39°N, 43°W, and only about 60 mi from the LOW's center, reported a 60-kn northwesterly wind. At 0000 on the 11th, the NEW ENGLAND TRAPPER was near 48.5°N, 40°W, with 60-kn northeasterly winds, 25-ft seas, and 31-ft swells.

The LOW was drifting southward with little change in intensity, but on the 12th, it circled to a northerly movement again and started filling. On the 14th, it split into two small centers. The PALLUS reported 45 kn and the EREW 60 kn near the center near 38°N, 38°W.

While the LOW described above was rotating around in the central ocean, a front moved off the U. S. East Coast. A wave formed on the front on the 12th. The DAWSON, east of the front (41°N, 58°W), was hit by 45-kn southerly winds. As is usual in meteorology, the unusual happens, and the frontal wave moved southeastward. The DART ATLANTIC was near 41°N, 55°W, at 0000 on the 13th, northwest of the 997-mb center pounding into 50-kn winds and 26-ft swell waves. At 1200, the DOCTOR LYKES (34°N, 56°W) logged 50-kn winds, and the BRITISH COMMODORE (36.5°N, 55°W) logged 40-kn winds with 31-ft seas. The winds in the northwest quadrant continued to blow up to 50 kn, and seas to 26 ft were reported by two vessels. In the southwest quadrant, the EL TAINO (33°N, 58.1°W) logged 45-kn winds, 10-ft seas, and 36-ft swells.

On the 14th, the LOW split into two centers, and another frontal wave formed near 45°N, 43°W. Winds of 40 to 50 kn were soon blowing around the new center. The ATLANTIC CONVEYOR was at 50°N, 46°W. The wind was 50 kn, the seas 16 ft, and the swell 30 ft. On the opposite side of the LOW, at 49°N, 40°W, the PIRAN had 45-kn southerly winds and 23-ft seas. This LOW became the primary LOW as the southern one filled and moved to the east and northeast.

Again, contrary to normal movement, this LOW tracked southward and then southeastward. At 1200 on the 16th, there was a ship report with the swell height coded as 25 (41 ft), but it was questionable. Several other ships reported 20-ft swells. The MORMACCAPE (36.3°N, 67.3°W) had 55-kn winds and 12-ft seas. At 0000 on the 17th, the 990-mb LOW was near 36°N, 43°W. Winds of 40 and 45 kn were reported south and east of the center.

The LOW continued to drift southeastward. At 1200 on the 19th, the STAR FJELLANGER (35°N, 31.5°W) radioed 55-kn winds. Twenty-four hours later (1200/20), the ROBERT TOOMBS (34°N, 34°W) was sailing into 40-kn gales. The LOW was still drifting in the gross vicinity of 32°N, 32°W, on the 23d, when the CINULIA found 50-kn winds with 33-ft seas near 39°N, 33°W. On the 24th at 0000, the ACT 1 found 50-kn winds and 23-ft waves at 34.7°N, 34.9°W. No other high wind or wave reports were received prior to dissipation of the LOW on the 27th.

Part of the explanation for the persistence of these LOWs over the central ocean was an upper-air cutoff LOW which persisted much of the month. To explain why it was there, if possible, would require more space and time than are available here.

A deep LOW moved out of Canada through the Davis Strait and into Baffin Bay on the 12th. On the 13th, a LOW formed on the old front in the Denmark Strait. A 1045-mb HIGH was centered near 54°N, 22°W, an extremely strong and unusual position for high pressure this time of the year. A tight gradient on the north side was producing strong winds. Four stations on Iceland reported 35- to 40-kn winds. Ocean Weather Station Mike reported 40-kn winds and 20-ft seas. The ISAKOGORKA, at 65°N, 05°E, radioed 45-kn winds, as did an island station off Norway.

By 1200 on the 14th, the 956-mb LOW had traveled to 71.5°N, 01°E. A ship near 66°N, 02°E, reported 25-ft seas. Ocean Weather Station Mike reported 45-kn winds and 33-ft seas at 0000 on the 15th. A ship, near 71.5°N, 17°E, was blasted by 60-kn winds of 2°C. The storm moved across Nordkapp with strong winds to all of Scandinavia.

This was another Cape Hatteras storm. A frontal wave was analyzed near Hatteras on the 0000 chart of the 18th. By 1200, the 990-mb storm was south of Cape Sable with a widespread circulation. The EXPORT LEADER was near the point of occlusion (40.3°N, 62.5°W) with 50-kn winds and 15-ft waves. At 1800, the AMERICAN LANCER found 60-kn winds and 18-ft waves at 44.7°N, 61.9°W.

At 0000 on the 19th, the storm center moved into the Gulf of St. Lawrence at 974 mb. The VICTORE and the VGNV, south of Cape Race, had 50-kn winds and 20-ft seas. The PITTSBURG, at 39.5°N, 59.6°W, also had 50-kn winds and 20-ft seas. At 1200, the PEARES had 55-kn winds near 41°N, 65°W, when the 962-mb storm was over Goose Bay. Many ships were reporting 40- to 50-kn winds.

On the 20th, the storm struck the southwest coast of Greenland, and a center broke off onto the east coast. Both centers raced northward along the respective coasts and dissipated.

This storm formed and moved along the Atlantic seaboard on the 26th. At 1200, the ESSO NEW ORLEANS measured 55-kn winds at 36°N, 73.9°W. At 0000 on the 27th, the 999-mb center moved over northern New England with the front paralleling the coast. It was west of Ocean Weather Station Hotel which reported 40-kn winds and 20-ft seas. The storm moved across Belle Isle on the 28th. Gales were blowing, especially east of the front. The LOW, which was now 976 mb, moved south of Iceland on the 29th. At 1200, Ocean Weather Station Lima logged 45-kn winds and 26-ft seas. Twelve hours later at 0000 on the 30th, Lima was still bravely battling 20-ft seas and 26-ft swells. By 1200, the highest waves had decreased to 23 ft. On the 30th, the storm was over the Norwegian Sea and moved over Scandinavia bringing 23-ft waves to Ocean Weather Station Mike.

Casualties--The POLA DE LAVIANA, a 9,950-ton motorship under construction at Gijon, Spain, was reported, on the 18th, to have broken her moorings during a storm and received heavy damage when she collided with a quay. The IMBROS, a 3,426-ton Cypriot freighter radioed that she was in distress 250 mi east of Savannah, Ga. When last heard from, the ship reported fighting 60-kn winds. The 4,054-ton Swedish CARITA ran aground in heavy weather, on the 20th, in Cabot Strait and later broke into three sections. All crew members were rescued.

A collision in fog on the Elbe River resulted in a 400-ton river barge sinking, a West German coastal vessel capsizing, and slight damage to the 10,122-ton Polish motorship MIECZYSLAW KALINOWSKI. During the last week, the 10,614-ton Somali motorship SINYEH caught and grounded during stormy weather off Latakia, Syria. The German TRANSLUBECA (1,205 tons) presumably sank after the cargo shifted in heavy weather, on the 31st, in the Gulf of Bothnia.

Smooth Log, North Pacific Weather

November and December 1975

SMOOTH LOG, NOVEMBER 1975--The tracks of the cyclone centers were widely dispersed this month. Over the western two-thirds of the ocean, they ranged from 30° to 60°N, and from 40° to 60°N over the eastern one-third. With a little imagination, three mean tracks could be discerned. One across the Sea of Okhotsk and then northward toward Wrangel Island, another from east of Japan northeastward to the Aleutians and the Gulf of Alaska, and another from 35°N in the central ocean eastward and then northeastward to the British Columbia coast. These roughly approximated the climatological tracks.

The mean sea-level pressure pattern resembled the climatological mean in the major features. The central pressures were more intense. The Aleutian Low consisted of two centers, a 998-mb over the Gulf of Alaska and a 1003-mb over the Bering Sea. The Pacific High at 1024 mb was normally located near 33°N, 135°W. An anomalous 1021-mb High was located near 40°N, 165°E.

There were four anomaly centers that directly might have affected the weather. A minus 5-mb center was located near Yakutat on the Alaskan coast. The western coast had a positive 3-mb center. The other two major centers were positive; a 5-mb near 37°N, 135°W, and an 8-mb near 58°N, 161°E.

The most significant difference in the upper-air pattern was over the Gulf of Alaska where a short-wave trough resulted in a large negative anomaly.

There were three tropical cyclones in the western ocean: tropical storm Helen and typhoons Ida and June. In the east, tropical storm Priscilla occurred during the first part of the month. See the article "Eastern North Pacific Tropical Cyclones, 1975" on page 125 in this issue.

Extratropical Cyclones--This was the extratropical continuation of tropical storm Grace. At 0000 on the 3d, the 1001-mb storm was near 33°N, 154°E. The LAURITA, at 36.2°N, 155.5°E, fought 56-kn winds and 26-ft swells. At 0000 on the 4th, the HAWAII was very near the center with 35-kn winds and 16-ft waves. On the 5th, the JAPAN MAIL was sailing into 40-kn gales at 25 kn. The EATON GLORIA measured 42-kn winds and 30-ft seas at 39.4°N, 157.4°W. At 1800, the GOLDENROD measured 60-kn winds and 46-ft seas at 47.8°N, 141.2°W.

On the 6th, the 962-mb LOW was approaching the U. S. West Coast. The GOLDENROD now measured 50-kn winds, 33-ft seas, and 25-ft swells. The ARCO SAG RIVER (48.2°N, 134.4°W) battled 60-kn winds and 44-ft seas. At 0000 on the 7th, the ARCO SAG RIVER had 50-kn winds, 41-ft seas, and 57-ft swells. About 0600 on the 7th, the LOW crossed into British Columbia, traveled to the east slopes of the Rocky Mountains, and turned northward and into the Arctic Ocean on the 12th.

A quasi-stationary closed LOW persisted over the Gulf of Alaska for many days. An average position would be approximately 59°N, 145°W, for the period November 7-15. This was not the same storm, but a combination of many LOWs, some very short-lived, that moved into the area to reinforce the system.

One of these had a long history. It originated over the East China Sea on the 6th. On the 8th, it had a 979-mb central pressure as it moved along the Kurils with gale-force winds. The AMERICAN CHIEFTAN encountered 45-kn winds and 30-ft waves, at 1800, at 41.3°N, 162°E. At 0000 on the 10th, the VAN FORT was near 48°N, 170°E, with 50-kn westerlies.

At the same time, the HOYO MARU, near 50°N, 175°E, reported 45-kn winds, 10-ft seas, and 28-ft swells. The LOW was north of the Aleutians and sweeping the islands with gales. On the 11th, the HOYO MARU (JEBE) was hit by 50-kn winds ahead of a trough out of the stationary LOW.

Various frontal waves were forming and moving around the Gulf of Alaska LOW. On the 12th, one of these probably was the mechanism that helped bring 65-kn typhoon-force winds to the NEWARK near 51.5°N, 133°W. The waves were reported as 25 ft. A ship, which appeared to be the AUSTRALIS, found 38-ft swells, south of the front, near 42.5°N, 140°W.

As the East China Sea LOW moved south of the stationary center, another frontal wave formed ahead of it, and there were more high wind reports. A ship reported 60-kn winds at 49.4°N, 127.8°W, and the CRESSIDA fought 50-kn winds near 50.5°N, 130°W. The SANSINENA also battled 50-kn southerly winds at 47.5°N, 131°W. Far to the west, but still in the large circulation, the ASIA BOTAN found a 50-kn wind band. Late on the 13th, the traveling LOW was absorbed into the main system. The NEWARK, at 48.8°N, 125.7°W, at 1800, was still battling winds of 60 kn, seas of 20 ft, and swells of 33 ft.

Another LOW was moving into the southern edge of the circulation. It had formed in midocean early on the 13th and raced eastward at about 50 kn. At 0000 on the 15th, it was 968 mb off the Washington coast. The CALIFORNIAN was along the front just prior to the wind shift, near 45°N, 130°W, with 70-kn southerlies and 20-ft waves. To the south EB-16 measured 40-kn winds and 31-ft seas. West of the center along 45°N and between 140° and 150°W, two ships, one the ASIA BOTAN, registered 60 kn. At 1200, the CALIFORNIAN was sailing into 60 kn. The waves could not be determined from the plot, but EB-16 indicated 21 ft. The NEWARK (48.7°N, 126.2°W) continued to survive 60-kn winds, 17-ft seas, and 33-ft swells. The new storm was 958 mb as it struck the coast north of Vancouver Island. At this time the stationary LOW could no longer be analyzed.

This was an eastern shore, western ocean storm. It originated over the East China Sea on the 14th. It took awhile to get together as it moved across Japan, but on the 16th, it was well organized. On the 17th, it was 989 mb and moving along the Kurils. Gales were blowing ahead of the front. At 1200, the NANSHO MARU was at 48°N, 166°E, with 50-kn southerlies. By 0000 on the 18th, the LOW was 956 mb and crossing into the Bering Sea. Ostrov Beringa measured 80-kn winds from the north-northeast. There were many gale reports south of the center. The NANSHO MARU among others reported 25-ft waves, and the DAISHIN MARU at 41.6°N, 174.7°E, many miles south and east of the center, had 33-ft swells slapping her starboard side. The SHUNWIND (51.5°N, 167.9°E) measured winds of 70 kn with 33-ft waves.

At 1200, Beringa was still measuring 80-kn; Anadyr, U.S.S.R., measured 60-kn; and Mys Navarin, 50-kn winds. The NANSHO MARU faithfully reported 50-kn and the AKAISHI MARU at 42°N, 175°E, found 55-kn winds and 23-ft waves. The SHOGEN MARU at 46°N, 179°E, was also plowing into 23-ft waves.

At 0000 on the 19th, the LOW was 960 mb with many high winds. Beringa was now 50 kn. The following ships plus Shima reported 50-kn winds southwest of the center: JUNEAU MARU, NELSON MARU, and TONAMI MARU. Far to the east in the Gulf of Alaska the AVILA experienced 50-kn easterlies. The CRESSIDA (45.1°N, 175.2°W) topped them all by measuring 65 kn, but she reported only 15-ft seas.

The LOW was now being squeezed by a high-pressure system to the south and another LOW from the west. It weakened rapidly and caused no more trouble.

The sea just south of Shikoku spawned this storm on the 19th. Under the influence of upper-air flow, the storm was steered northeasterly at about 40 kn. Fed by the Kuroshio Current, it deepened rapidly. By 1200 on the 20th, the 970-mb LOW was near 45°N, 160°E. The following three ships reported 60-kn storm winds and waves as indicated in the southern half of the circulation: AKAISHI MARU, 30 ft (41°N, 164°E); SATSUMACORE, 33 ft (42.8°N, 157°E); and SEIRAN MARU, 16 ft (41.3°N, 158°E). Other ships reported 40- to 50-kn winds and seas to 23 ft.

Twelve hours later at 0000 on the 21st, the 7LSP reported 75-kn typhoon-force winds at 48.7°N, 171.3°E, about 100 mi southwest of the center. The significant waves were 20 to 23 ft. Ships were observing gales to storm winds up to 600 mi distance. At 1200, many island stations measured 40-kn prevailing winds. The TONAMI MARU (50.5°N, 171.5°E) recorded 50 kn and 26-ft waves. On the 22d at 0000, the pressure was 946 mb. The PANASIA was beaten by 60-kn winds. The FREESIA, near 47.5°N, 172.5°E, reported 33-ft seas and 49-ft swells. At 1200, Adak reported a pressure of only 952 mb. At 1800, the GOLDENROD measured 41-kn winds and 35-ft seas at 53.8°N, 175.6°W.

The LOW crossed the Aleutians and headed southeastward on the 22d. The JUJO MARU found 33-ft swells about 150 mi west-southwest of the center. About 400 mi due south, a ship was sailing into 36-ft swells. On the 23d, the PRESIDENT PIERCE had 50-kn winds, 17-ft seas, and 41-ft swells, at 41°N, 178.4°E, and the PLUVIUS had 44-kn winds, 7-ft seas, and 46-ft swells at 34°N, 177.3°W.

Late on the 23d and on the 24th, there was an explosive filling of the LOW--36 mb in 24 hr. Late on the 24th, there was no trace of the storm.

Tropical Cyclones, Western Pacific--Tropical storm Helen flared up briefly in the South China Sea. She was detected as a tropical storm on the 3d about 320 mi west of Manila. Moving westward and generating 35-kn winds near her center, Helen landed on the Vietnam coast near Nha Trang on the 4th.

Two days later a depression was detected about 300 mi southeast of Guam. This was the beginning of Ida. Moving northward she reached tropical storm strength on the 7th before crossing the 15th parallel. She continued to intensify while accelerating toward the north-northwest. On the 9th, she crossed the 20th parallel near 145°E and shortly thereafter became a typhoon. Ida then turned toward the north-northwest and continued to accelerate. On the 10th, she was moving at a forward speed of about 25 kn, and by the 11th this was up to 40 kn. Her winds during this period were 80 to 85 kn. The PLUVIUS at 35°N, 155°E, suffered 50-kn winds and 33-ft swells. By the 12th, she was

extratropical at 40°N, 158°E. The GRAND CARRIER and TOYOTA MARU both found 50-kn winds as far as 300 mi from the center. The TOYOTA MARU had 16-ft seas (300°) and 33-ft swells (350°).

On the 13th, the central pressure of ex-Ida had risen to 994 mb, but gales were still found in all quadrants. By the 14th, the gradient would no longer support gale-force winds.

Typhoon June was the superstorm of the year. Late on November 19, an aircraft reconnaissance team reported a pressure of 875 mb. If this reading holds up under poststorm analysis, it will become the lowest pressure ever recorded at sea level. The current mark is 877 mb set in 1958 by typhoon Ida and again in 1973 in typhoon Nora.

June developed near Woleai atoll on the 16th. She meandered northward, but intensified rapidly. She was a typhoon by the 18th. On the 19th, maximum winds increased from 105 kn to a peak of 160 kn with 195-kn gusts. During the day she passed 200 mi to the west of Guam, which was buffeted by 43-kn winds with gusts to 55 kn. After reaching her peak intensity (maximum winds and lowest pressure, June swung toward the northwest. She crossed the 15th parallel on the 20th as winds began to drop. On the 21st, the CHEVRON FRANKFURT (15.6°N, 134.6°E) measured 60-kn winds and 41-ft seas. By the 22d, June began to recurve toward the north, then northeastward. The storm continued to weaken as cold air began to intrude. However, winds remained above 100 kn until the 23d, when she passed 100 mi north of Chichijima. June was turning extratropical and racing northeastward at 60 kn at this time.

On the 24th, the ANTARCTIC was not concerned with whether June was tropical or extratropical, only with the 65-kn winds she encountered about 60 mi from the center. At 1200, a strong frontal system was well entrenched into the storm, and the center had raced to 47°N, 170°E, at about 65 kn. Gale-force winds were common. On the 25th, it crossed the Chukotskiy Peninsula into the Arctic Ocean with coastal stations measuring winds as high as 55 kn.

Casualties--The 2,993-ton Japanese GINSEI MARU dragged anchor during strong winds and heavy seas and grounded in the outer harbor at Mukho, Korea, on the 14th. The 3,000-ton KETAMA capsized during a storm, on the 23d, 180 mi northeast of Kuala Lumpur. One crew member died, and four were missing.

Another lightning casualty. The 2,566-ton fuel oil cargo barge was struck by lightning while cleaning oil sludge, on the 26th, at Singapore. Several explosions occurred followed by fire. Damage to the vessel was extensive.

SMOOTH LOG, DECEMBER 1975--The number of cyclone centers traversing the North Pacific was above normal this month. The primary tracks were shifted south and east of their normal location and less concentrated. The average track of most concentration begins at latitude 35°N near Japan, to 40°N in midocean, to the Gulf of Alaska. Early and late in the month, there were three cyclones that tracked south of latitude 30°N prior to turning northeastward near midocean.

The mean pressure pattern over the North Pacific was more normal than in the North Atlantic. The Aleutian Low had two centers--996 mb and 1000 mb--versus 1002 mb and 1001 mb as indicated by climatology. They were over the southern Bering Sea and the Gulf of Alaska, respectively. The Pacific High was 1025 mb, near 35°N, 130°W, versus 1020 mb near 30°N, 130°W, according to climatology.

The most significant negative anomaly was 7 mb near 50°N, 175°W, indicating the lower pressure and slight displacement of the Aleutian Low over the Bering Sea. The higher pressure and northward shift of the Pacific High resulted in a large area of positive anomaly off and over the northwestern United States with several 6-mb centers. A smaller 6-mb positive anomaly was north of Kamchatka over eastern Siberia.

The upper-air flow was mainly zonal between latitudes 30° and 50°N from Japan to longitude 160°W. East of 160°W, the flow turned northeastward to pass over a ridge over the Rocky Mountains. There was a 59-m (194 ft) negative anomaly center near 50°N, 175°W, and a 65-m (214 ft) positive anomaly center near 43°N, 124°W.

There were no tropical cyclones this month.

Extratropical Cyclones--This was one of the storms that formed and tracked south of latitude 30°N. It formed on the 2d and tracked eastward, turning northeastward on the 3d. The first gales were reported on the 4th. The EASTERN MARINER (32°N, 166°E) and the MILENA (31.5°N, 173°E) both reported 40-kn gales and waves of 16 ft.

There were isolated gale reports as the storm traveled northeastward. At 0000 on the 6th, the 977-mb storm was centered near 48.5°N, 171°W. The BELMAR was many miles to the east, near 52°N, 158°W, sailing with 50-kn easterlies and 33-ft waves. The NICKOLAY KARAMZIN (46°N, 151°W) was east of the front with 40-kn southerly winds and 20-ft seas. Gales were blowing south of the center with seas to 20 ft. The storm crossed the Gulf of Alaska on the 8th and was lost near Sitka.

When the last storm dissipated over the mountains of British Columbia, a weak LOW was left behind in the Gulf of Alaska. On the 12th, a front extending from a LOW over the Bering Sea was incorporated into its circulation and brought new energy. At 1200 on the 12th, the LOW was 992 mb. The PORTLAND was near the center, at 57°N, 144°W, with 45-kn winds. At 0000 on the 13th, the TOYO MARU (52.5°N, 135.5°W) had 50-kn winds and 26-ft seas and swells. The AVILA, at 53°N, 139°W, was fighting 45-kn winds and 20-ft seas. At 0600, the PRESIDENT MADISON, at 49.3°N, 133°W, fought 45-kn winds, 20-ft seas, and 31-ft swells. The storm had been moving south along the coast and by 1200 had pounded itself out on the rocky coast.

Monster of the Month--For the first half of its life, this LOW followed the average primary storm path. It then turned more northward than the mean track and into the Bering Sea. It formed on the 11th southeast of Tokyo. On the 12th, there were reports of 40-kn winds on each side of the center. The SEA-LAND RESOURCE was west of the center, at 37°N,

148°E, with 16-ft waves. At 0300 on the 13th, the PRESIDENT PIERCE (34.8°N, 161.3°E) was swept by 60-kn winds, 15-ft seas, and 25-ft swells. At 0600, the JAWAGA (37.3°N, 160.5°E) had 50-kn winds and 33-ft seas. By 1200, the 980-mb LOW was near 40°N, 167°E. The KURE MARU, near 37.5°N, 165°E, had 50-kn winds, 20-ft seas, and 34-ft swells striking her starboard side. At 0000 on the 14th, the AMERICAN APOLLO, 600 mi south of the center, found 40-kn winds and 25-ft swells. Near the center and north of it, the DATAN MARU battled 50-kn winds, while the KATORI MARU fought 55-kn winds. At 1200, the HARUNA MARU, near 39.5°N, 176.5°E, 550 mi south of the 954-mb center, was barely making headway into 55-kn winds, 12-ft seas, and 39-ft swells. Twelve hours later, she still had the same winds and seas, but the swell had dropped to 30 ft.

On the 15th at 0000, the SEALAND FINANCE (39.5°N, 178°E) had devastating 41-ft swells. At 1200, the LOW crossed into the Bering Sea near Adak. There were many gale reports but no especially high winds and waves reported. The same applied on the 16th and 17th. On the 18th, the LOW stalled near 57°N, 175°W, and gradually filled as other storms moved south of the Aleutians.

This storm was born in the same general area as the previous one, southeast of Tokyo, on the 15th. It was much weaker in its initial phases bringing only clouds and precipitation as it moved eastward. On the 17th, it reverted to only a frontal wave, but on the 18th, it got a shot in the arm as it moved onto the front side of the major trough, and a minor trough was detectable at 700 mb.

At 1200 on the 18th, the LOW was 972 mb near 45°N, 156°W. The PHEMIUS was about 100 mi east of the center with 45-kn southerly gales and 23-ft waves. Twelve hours later, the central pressure had dropped to 956 mb. A ship at 54°N, 148°W, called in with 60-kn southeasterly winds and 16-ft seas. Many ships were reporting gales. Ocean Weather Station Papa measured 45-kn prevailing winds and 18-ft seas.

The storm had moved to 57°N, 151°W, by 1200 on the 19th. The BREWSTER, near 54.5°N, 152°W, suffered 50-kn winds. The SUMMIT (53°N, 139°W) reported clear skies with 50-kn winds, 13-ft seas, and 34-ft swells. Papa was out of the major wind band with only 35 kn, but the seas were 33 ft. A report by the SULEYMAN STALSKIY appeared to be 65 kn. There were no seas plotted to help verify the wind. On the 20th, the storm moved inland and was lost over the Alaska Range, but not before the PHILADELPHIA confronted 35-ft swells at 58°N, 146.3°W.

The claim to fame of this storm was its low pressure. On the 0000 chart of the 23d, there were seven LOW centers between latitudes 37° and 60°N and the coasts of the continents. One of these, near 37°N, 178°W, had just formed at 992 mb. There was very strong zonal flow aloft as it raced eastward and deepened. By 0000 on the 24th, the pressure had plunged to 948 mb near 44°N, 161°W. At that time, both JAG ASHA and SEVILLAN REEFER reported 50-kn winds south of the center with the latter fighting 20-ft seas and 23-ft swells. North of the center the SEA-LAND MCLEAN was plowing into 45-kn gales and 18-ft waves. By 1200, the LOW was down to 926 mb near 49°N, 156°W. The LOW and the MCLEAN nearly crossed paths about 1000 and reported a pressure of 939 mb.

At 0000 on the 25th, the LOW was analyzed as 928 mb. The INDUS, near 48°N, 151°W, sent in a storm report of 60-kn winds and 41-ft waves. The VANCOUVER ISLAND, near 51.5°N, 164°W, was plotted as having 40-kn winds, 20-ft seas, and 62-ft swells. The swell direction was coded as 99 and period 8.

Late on the 25th and 26th, the storm was filling, and there were isolated gale reports. One that did not fit that category was from the COLUMBUS CANADA (39.6°N, 139.5°W) for 52-kn winds, 30-ft seas, and 33-ft swells. On the 27th, the storm stalled over the Alaska Peninsula and disappeared by the 28th.

Casualties--The American-registered JOHN LYKES (11,891 tons) arrived Honolulu, on the 10th, with heavy weather damage resulting from four bulldozers coming adrift. The 15,934-ton British freighter LONDON PIONEER suffered an explosion in the engineroom during rough seas, 800 mi north-northeast of Oahu. Two crewmen were injured. The 9,595-ton Norwegian KRISTIN BAKKE with a doctor aboard was standing by as heavy seas prevented transfer operations. The 946-ton Panamanian INDAH sank during heavy weather, on the 16th, and 17 crew were missing. The 32,269-ton STONEWALL JACKSON sustained heavy weather damage, on the 22d, on a voyage for Middle East and Indian ports. The 10,203-ton bulkcarrier KEN LUNG developed cracks in the shell plating during heavy weather off Nagasaki. The 2,771-ton DIAMOND BELLE grounded at Simara Island, on the 27th, during a storm. On the 29th, the 3,512-ton REBECCA LU sank during a storm, near 19.6°N, 120.1°E, after taking in water. Nine crew were missing.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

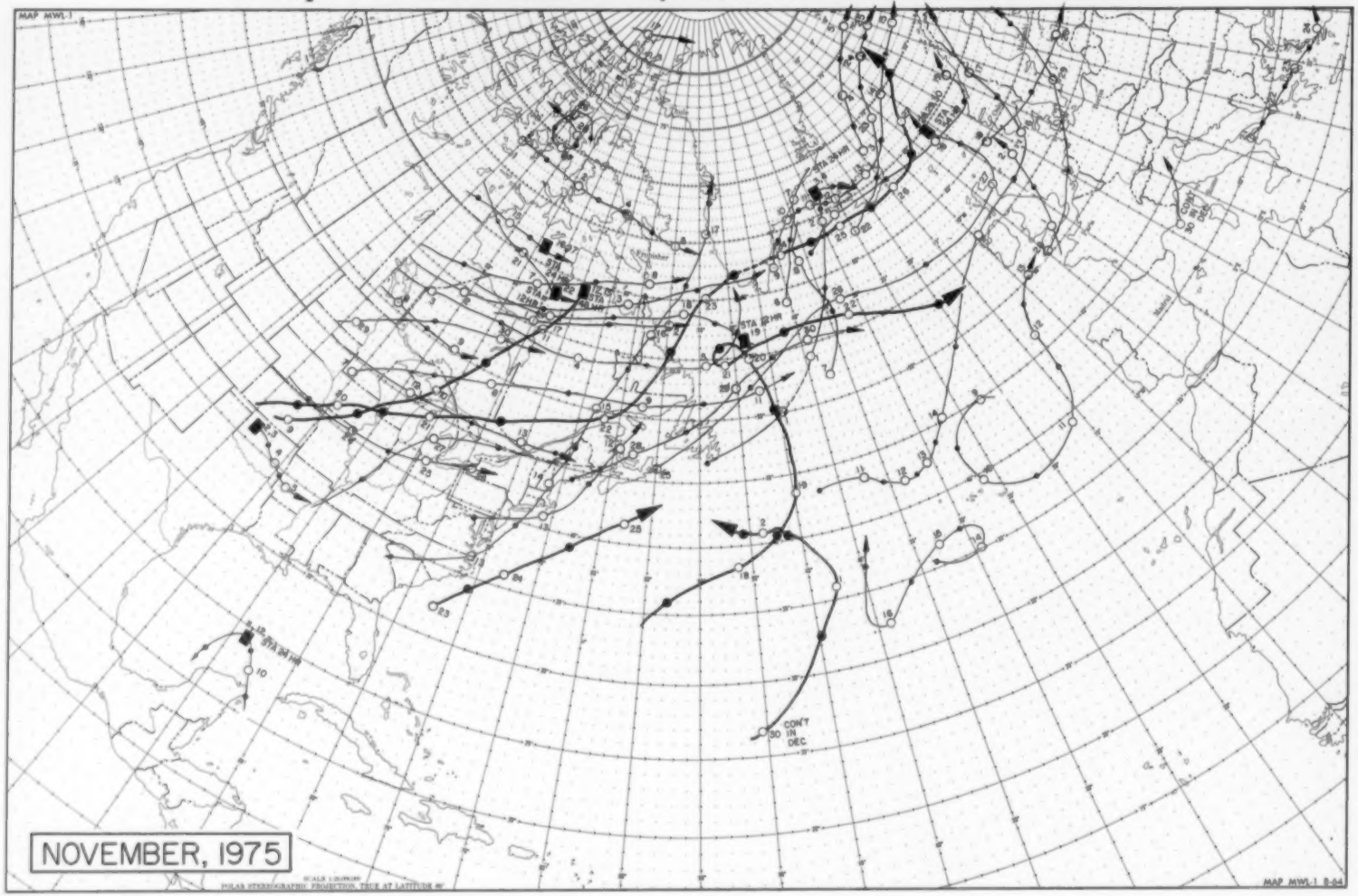


Figure 38. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

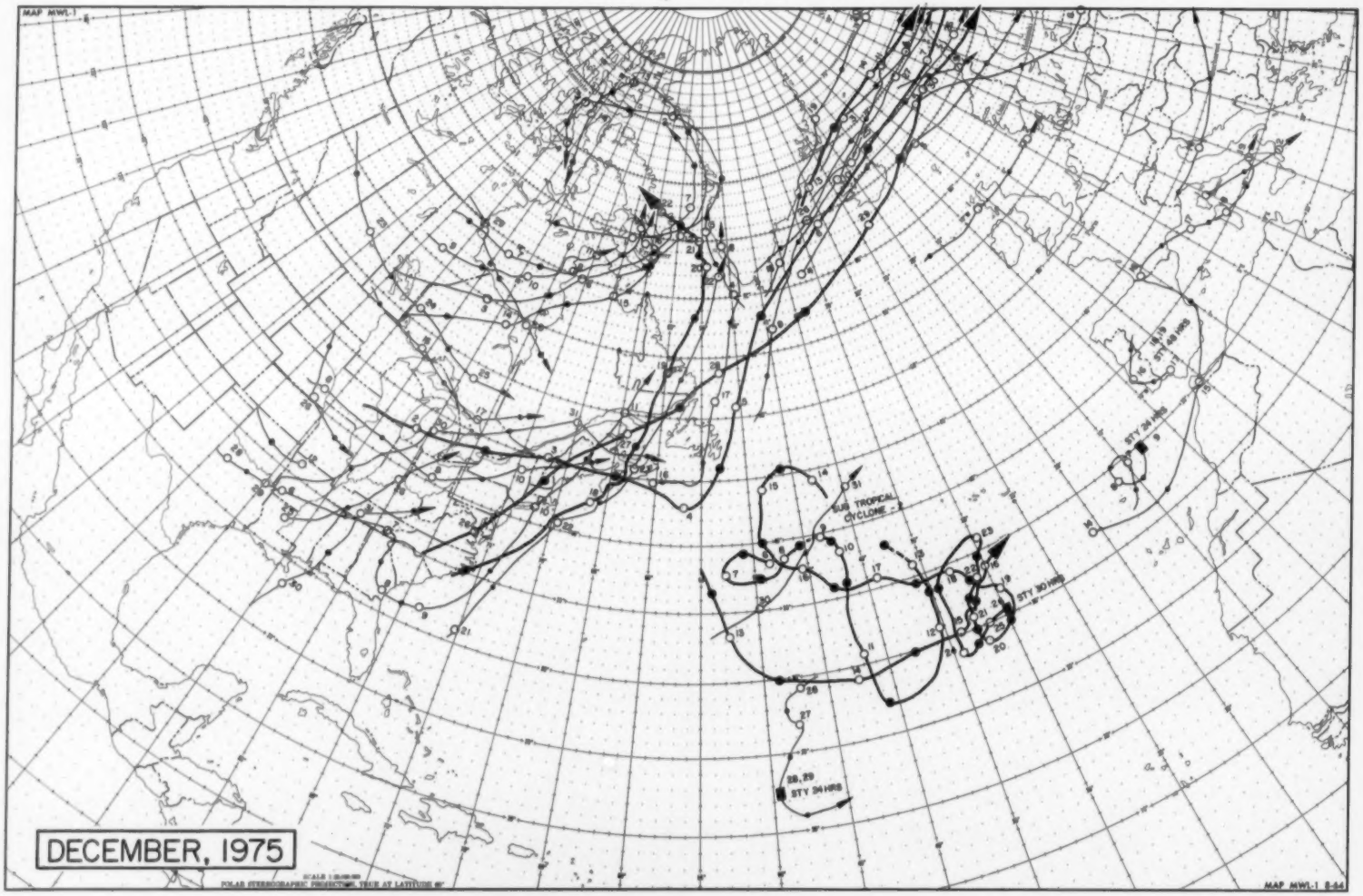


Figure 39. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

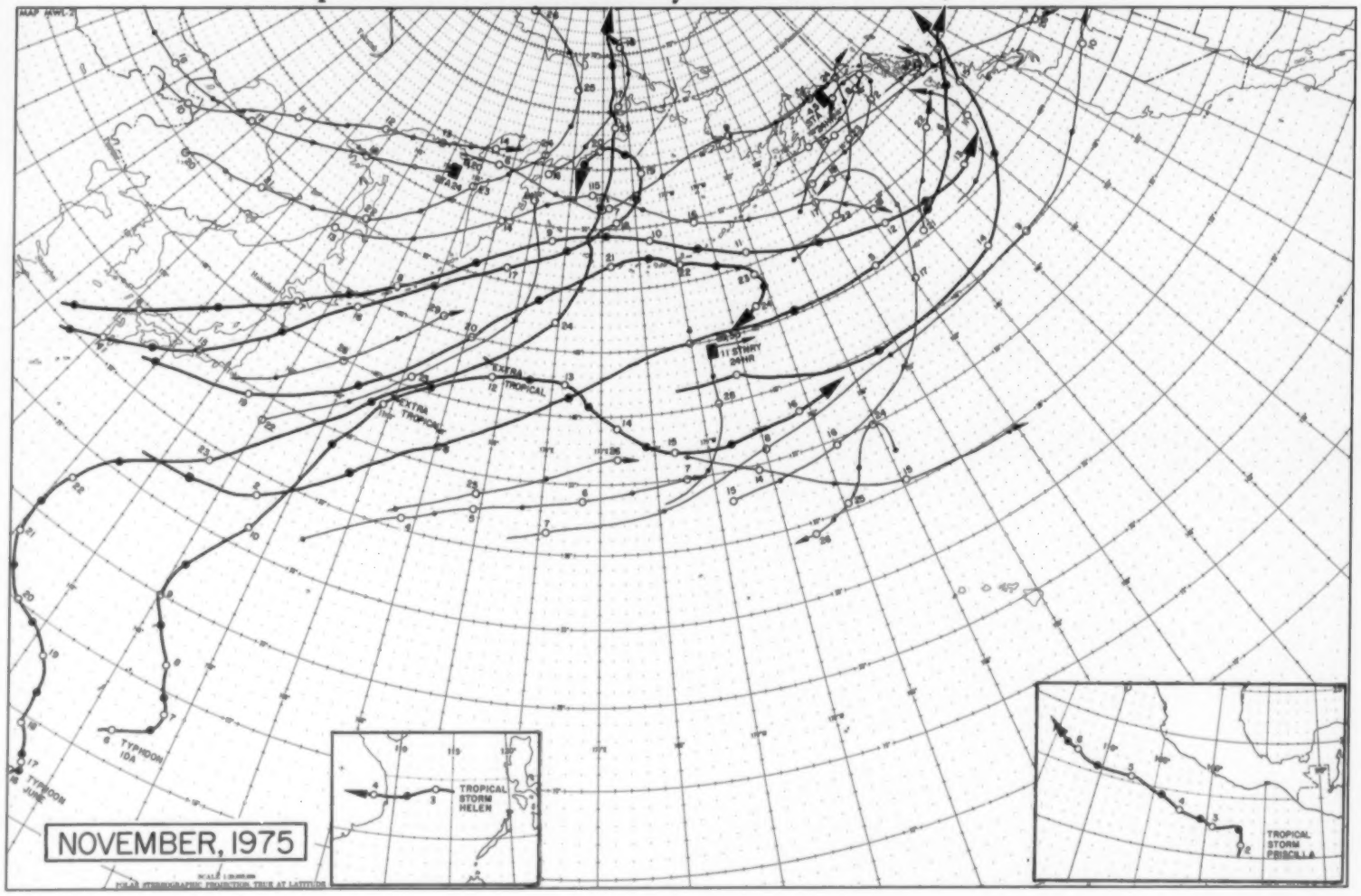


Figure 40. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

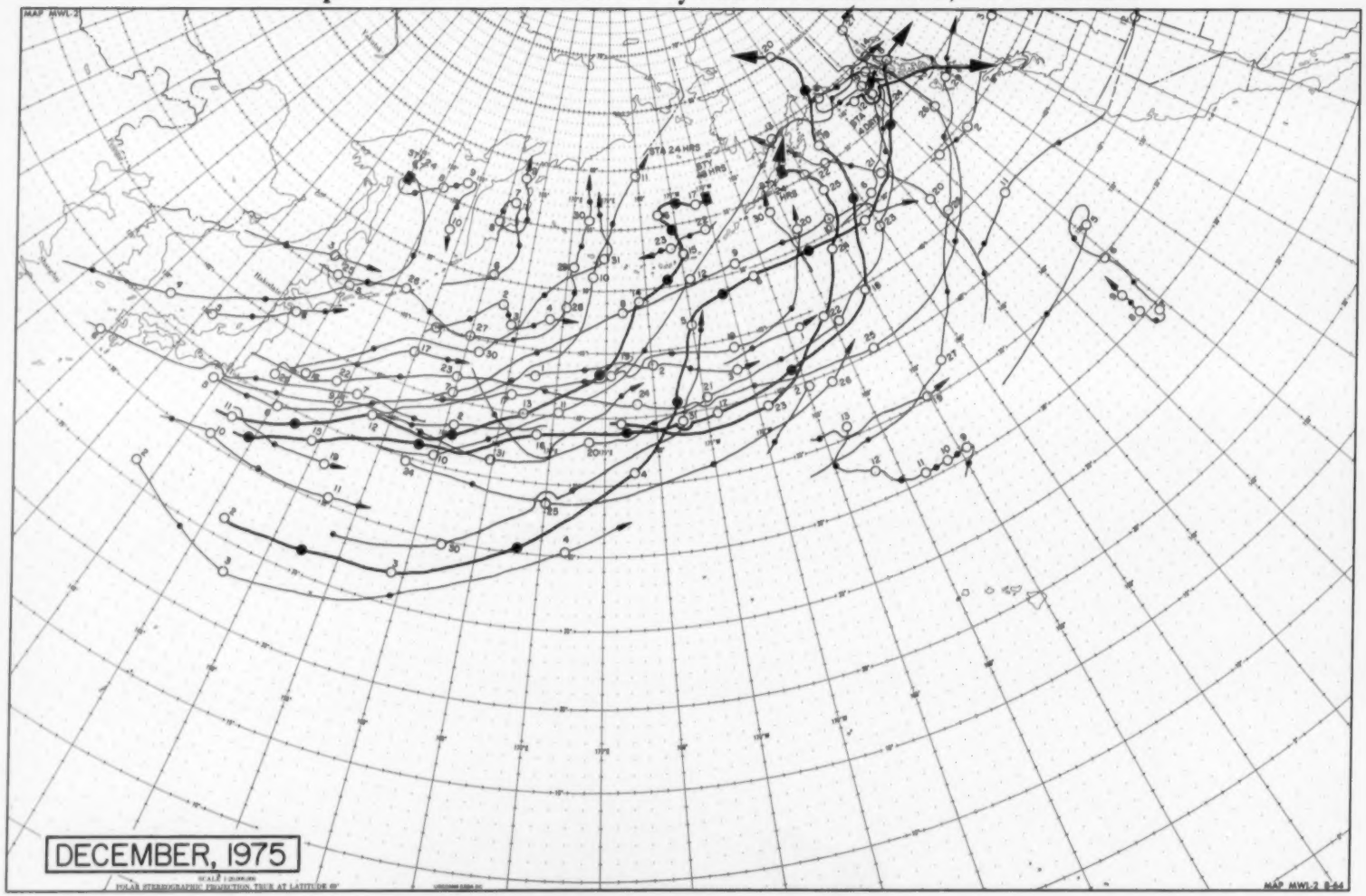


Figure 41. -- Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 16
U. S. Ocean Weather Station Climatological Data

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W **November and December, 1975**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
NOV	9.1	13 03	18.8	27.0	10 18	1.4	13 12	11.6	20.3	13 19	19.5	22 15	19.6	23.7	03 19	- 9.9	13 09	- 2.9	2.5	07 21
DEC	1.3	19 12	11.8	19.7	26 19	- 9.0	20 00	7.1	19.1	27 00	14.2	20 00	17.2	22.0	29 00	-18.0	29 00	- 9.4	1.9	10 12

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRIZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	SOBS WITH PCPN	NO OF OBS
NOV	995.2	14 00	1020.2	1039.1	30 03	30.5	24.3	26.4	18.8	53.5	19.7	20.1	6.7	19	10	0	0	1	3	0	0	30	8.3	240
DEC	998.4	22 06	1020.4	1038.2	14 03	6.9	12.9	34.7	45.6	21.4	24.2	30.3	18.1	21	21	2	1	9	11	0	0	31	15.9	248

** VV-90-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

NOV WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	5.6	6.6	2.9	.4	.0	15.5	15.2
NE	.8	3.4	1.7	1.4	.9	.8	8.2	19.7
E	.0	3.8	.8	.0	.3	.0	4.9	9.2
SE	.4	4.0	1.6	.0	.9	.0	6.9	8.0
S	.0	5.5	9.5	3.5	.0	.0	17.4	14.6
SW	.8	2.7	5.4	1.7	.4	.0	11.0	13.7
W	.8	2.8	5.6	3.3	.0	.0	13.0	14.2
NW	.8	3.0	11.4	5.9	.0	.0	21.4	14.9
CALM	.0	.0	.0	.0	.0	.0	.0	
TOTAL	5.0	30.8	44.6	18.8	2.1	.0	100.0	14.9

NUMBER OF OBS	MAX WIND DIR	SPEED	DA	HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
240	060	44	24	0900	5.0	286	

DEC WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.4	2.5	5.7	1.6	1.4	.0	11.7	17.1
NE	.8	2.0	4.7	3.9	.0	.0	12.1	16.9
E	.0	.4	3.6	4.6	.0	.0	8.7	21.1
SE	.4	.8	2.6	.1	.0	.0	3.9	13.8
S	.0	1.6	6.1	1.5	1.3	.0	10.6	18.9
SW	.0	1.3	7.8	2.7	.3	.0	11.8	17.8
W	.0	1.1	6.9	1.8	.0	.0	9.8	17.3
NW	.4	1.3	8.4	13.5	6.7	.0	30.2	23.8
CALM	1.2	.0	.0	.0	.0	.0	1.2	.0
TOTAL	3.2	11.7	45.8	31.9	9.7	.0	100.0	20.0

NUMBER OF OBS	MAX WIND DIR	SPEED	DA	HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
248	310	47	24	0300	7.1	312	

Wave

NOV WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	9.5	4.4	3.3	1.1	.0	.0	.0	18.3
NE	.4	7.3	3.1	1.4	2.3	.0	.0	.0	14.5
E	.0	1.3	.0	.0	.3	.0	.0	.0	1.6
SE	.4	1.1	.0	.0	.0	.0	.0	.0	1.6
S	2.0	11.2	2.0	1.1	.0	.0	.0	.0	16.4
SW	.5	5.5	1.5	2.5	.4	.0	.0	.0	10.4
W	.8	5.3	2.4	4.1	.0	.0	.0	.0	12.6
NW	.0	8.9	9.6	4.3	.8	.0	.0	.0	23.5
IND	.4	3.3	.4	.0	.0	.0	.0	.0	4.2
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	4.6	53.4	23.3	16.7	5.0	.0	.0	.0	100.0

NUMBER OF OBS 240 IND-INDETERMINATE

DEC WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	8.6	4.4	2.8	2.9	.0	.0	.0	18.7
NE	.1	5.8	4.2	2.1	.5	.0	.0	.0	12.6
E	.3	3.6	3.1	1.9	.3	.3	.0	.0	8.9
SE	.0	.7	1.9	.1	.0	.0	.0	.0	2.7
S	.0	4.0	4.1	2.1	.7	.7	.0	.0	11.7
SW	.0	4.8	2.1	1.8	.5	.1	.0	.0	9.4
W	.4	3.9	3.9	.8	.0	.0	.0	.0	9.1
NW	.0	1.7	8.8	5.2	9.2	.0	.0	.0	24.9
IND	.0	1.2	2.0	.8	.0	.0	.0	.0	4.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.8	32.3	34.7	17.3	14.1	.8	.0	.0	100.0

NUMBER OF OBS 248 IND-INDETERMINATE

NOV WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	3.3	20.7	5.4	.8	.0	.0	.0	.0	30.3
6-7	.4	10.8	18.3	11.3	1.3	.0	.0	.0	40.0
8-9	.4	9.6	1.3	4.2	3.8	.0	.0	.0	19.2
10-11	.0	.0	.0	.4	.0	.0	.0	.0	.4
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.4	3.3	.4	.0	.0	.0	.0	.0	4.2
TOTAL	4.8	53.4	23.3	16.7	5.0	.0	.0	.0	100.0

NUMBER OF OBS	HGT	MAX WAVE HEIGHT PER	DIR	TYPE	DA	HR	(IND-INDETERMINATE (DIR IN DEGREES)
240	9.0	9	040	SWL	24	21	

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

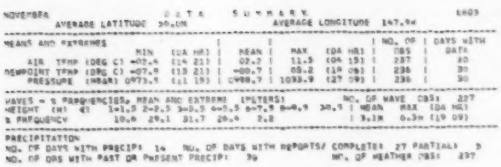
DEC WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.8	15.3	6.0	.0	.0	.0	.0	.0	22.2
6-7	.0	8.1	22.2	9.3	4.0	.0	.0	.0	43.5
8-9	.0	7.3	4.0	6.9	10.1	.8	.0	.0	29.0
10-11	.0	.4	.4	.4	.0	.0	.0	.0	1.2
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	1.6	2.0	.8	.0	.0	.0	.0	4.0
TOTAL	.8	32.3	34.7	17.3	14.1	.8	.0	.0	100.0

NUMBER OF OBS	HGT	MAX WAVE HEIGHT PER	DIR	TYPE	DA	HR	(IND-INDETERMINATE (DIR IN DEGREES)
248	6.0	9	170	SWL	24	21	

For each observation, the higher wave of the sea/swell group was selected for summarization. If heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 17
U. S. Ocean Buoy Climatological Data
November and December 1975



NOVEMBER 6803 — DATA SUMMARY — AVERAGE LATITUDE 30.0N, AVERAGE LONGITUDE 147.9W

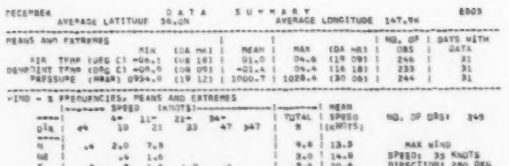
MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	-02.4	(14 21)	02.2	11.9	(04 15)	237	30
DEWPOINT TEMP (DEG C)	-07.9	(13 21)	-00.7	03.2	(19 06)	236	30
PRESSURE (MBAR)	0971.1	(11 18)	0998.7	1030.9	(27 09)	236	30

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 227

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-8.9	>8.9	MEAN	MAX (DA HR)
% FREQUENCY		10.6	29.1	31.7	20.4	8.8			2.3M	6.3M (19 09)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 14 NO. OF DAYS WITH REPORTS/ COMPLETES: 27 PARTIALS: 3
NO. OF DAYS WITH PAST OR PRESENT PRECIP: 14 NO. OF WEATHER OBS: 237



DECEMBER 6803 — DATA SUMMARY — AVERAGE LATITUDE 30.0N, AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	-06.1	(08 18)	01.0	04.6	(19 09)	246	31
DEWPOINT TEMP (DEG C)	-08.6	(08 09)	-01.4	04.4	(16 18)	238	31
PRESSURE (MBAR)	0994.6	(19 12)	1020.7	1028.6	(30 06)	244	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%	.4	2.0	7.8				9.8
N		.4	1.6				2.0
NE		.4	1.6				2.0
E	.4	.8	1.6	4.9	.4		8.1
SE		.8	2.0	4.9			7.7
S	.8	2.0	9.8	2.9			15.5
SW		3.4	10.6	2.0			16.1
W		2.4	11.8	7.8	.4		22.4
NW		2.9	9.8	3.3			15.9
CALM							
TOTAL	1.6	13.9	58.0	25.3	.8		100.0

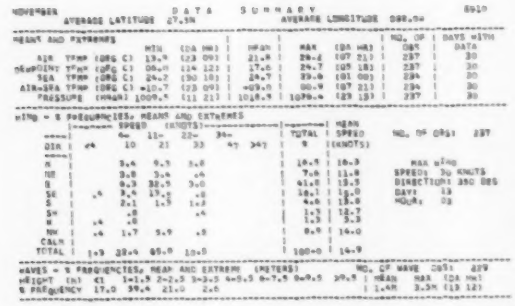
MEAN WIND SPEED: 35 KNOTS; DIRECTION: 280 DEG; DAY: 14; HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 233

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-9.5	>9.5	MEAN	MAX (DA HR)
% FREQUENCY			4.3	27.9	33.9	21.5	9.4	3.0	3.7M	9.5M (19 18)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 19 NO. OF DAYS WITH REPORTS/ COMPLETES: 28 PARTIALS: 2
NO. OF DAYS WITH PAST OR PRESENT PRECIP: 20

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING: MODERATE:14.0% SEVERE: NONE NO OBS: 246



NOVEMBER 6810 — DATA SUMMARY — AVERAGE LATITUDE 47.5N, AVERAGE LONGITUDE 080.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	13.9	(23 09)	21.8	29.4	(07 21)	237	30
DEWPOINT TEMP (DEG C)	06.0	(14 12)	17.6	24.7	(05 18)	237	30
SEA TEMP (DEG C)	24.2	(30 18)	26.7	29.0	(01 00)	234	30
AIR-SEA TEMP (DEG C)	-10.7	(23 09)	-05.0	00.9	(07 21)	234	30
PRESSURE (MBAR)	1009.5	(11 21)	1018.9	1029.4	(29 13)	237	30

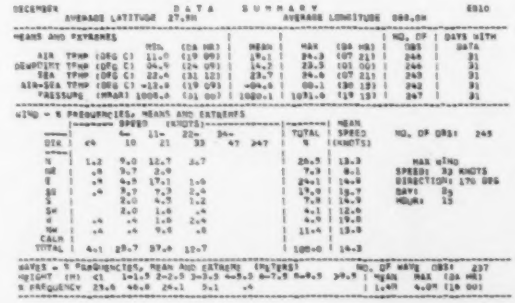
WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%		3.4	9.3	3.8			16.5
N		3.8	3.4	.4			7.6
NE		9.3	32.2	3.0			41.6
E		3.4	13.2	1.3			18.1
SE	.4	2.1	1.3	1.3			4.6
S		.8		.4			1.3
SW		.8					1.3
W	.4						0.8
NW		.4	1.7	5.9	.8		8.8
CALM							
TOTAL	1.3	23.4	65.0	10.8			100.0

MEAN WIND SPEED: 34 KNOTS; DIRECTION: 280 DEG; DAY: 13; HOUR: 03

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-8.9	>8.9	MEAN	MAX (DA HR)
% FREQUENCY		17.0	39.4	21.0	2.6				1.4M	3.5M (19 12)



DECEMBER 6810 — DATA SUMMARY — AVERAGE LATITUDE 47.5N, AVERAGE LONGITUDE 080.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	11.0	(19 09)	19.1	24.3	(07 21)	244	31
DEWPOINT TEMP (DEG C)	04.9	(24 09)	14.2	23.5	(01 00)	244	31
SEA TEMP (DEG C)	22.4	(31 12)	23.7	24.0	(07 21)	243	31
AIR-SEA TEMP (DEG C)	-12.8	(19 09)	-09.4	00.1	(30 12)	242	31
PRESSURE (MBAR)	1008.0	(31 00)	1020.1	1031.0	(19 13)	247	31

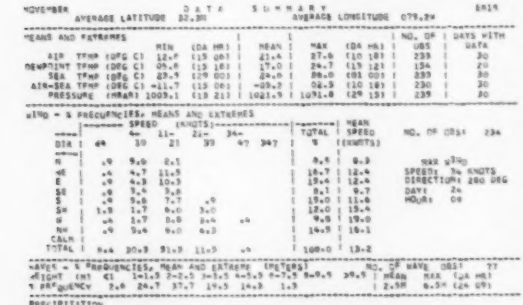
WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%	1.2	9.0	12.7	3.7			26.5
N	.8	3.7	2.4				7.3
NE	.8	4.5	17.1	1.0			24.1
E	.4	3.7	7.3	2.4			13.9
SE		2.0	4.5	1.2			7.8
S		2.0	1.6	.4			4.1
SW		.4	1.6	2.4			4.9
W	.4	.4	1.6	.4			2.8
NW	.4	.4	9.8	.8			11.4
CALM							
TOTAL	4.1	29.7	57.0	12.7			100.0

MEAN WIND SPEED: 33 KNOTS; DIRECTION: 170 DEG; DAY: 29; HOUR: 15

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 237

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-8.9	>8.9	MEAN	MAX (DA HR)
% FREQUENCY		23.6	40.0	24.1	9.1	.4			1.4M	4.0M (19 00)



NOVEMBER 6815 — DATA SUMMARY — AVERAGE LATITUDE 32.3N, AVERAGE LONGITUDE 079.2W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	12.9	(15 06)	21.4	27.0	(10 18)	239	30
DEWPOINT TEMP (DEG C)	05.6	(15 18)	17.0	24.7	(13 12)	154	20
SEA TEMP (DEG C)	23.9	(29 00)	24.6	26.0	(01 00)	239	30
AIR-SEA TEMP (DEG C)	-11.7	(13 06)	-03.2	02.9	(10 18)	230	20
PRESSURE (MBAR)	1009.1	(13 21)	1021.9	1031.8	(29 15)	239	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

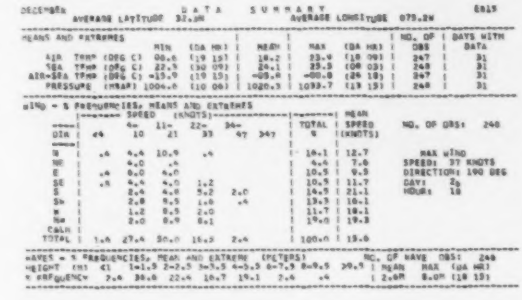
DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%	.9	9.9	2.1				8.5
N	.4	4.7	11.9				16.7
NE	.9	4.3	10.3				15.4
E	.9	5.4	3.8				9.1
SE	.9	9.9	7.7	.9			19.0
S	1.3	1.7	0.0	3.0			6.0
SW	.4	1.7	0.8	0.4	.4		9.8
W	.9	9.4	9.0	4.3			14.9
NW							
CALM							
TOTAL	6.4	30.9	31.9	11.9	.9		100.0

MEAN WIND SPEED: 34 KNOTS; DIRECTION: 280 DEG; DAY: 24; HOUR: 09

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 77

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-8.9	>8.9	MEAN	MAX (DA HR)
% FREQUENCY		3.8	24.7	37.7	19.5	14.3	1.3		2.5M	6.5M (26 09)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 5 NO. OF DAYS WITH REPORTS/ COMPLETES: 26 PARTIALS: 4
NO. OF DAYS WITH PAST OR PRESENT PRECIP: 11



DECEMBER 6815 — DATA SUMMARY — AVERAGE LATITUDE 32.3N, AVERAGE LONGITUDE 079.2W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	08.6	(19 12)	18.2	23.4	(18 09)	247	31
SEA TEMP (DEG C)	22.5	(30 09)	24.1	25.3	(09 03)	248	31
AIR-SEA TEMP (DEG C)	-13.9	(19 15)	-05.8	-00.8	(26 18)	247	31
PRESSURE (MBAR)	1004.8	(10 06)	1020.3	1032.7	(19 15)	248	31

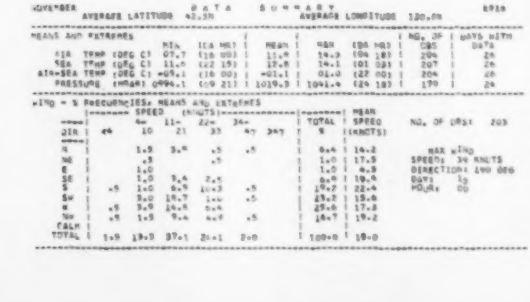
WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%	.4	4.4	10.9	.4			16.1
NE		4.0	.4				4.4
E	.4	6.0	4.0				10.5
SE	.8	4.4	4.0	1.2			10.5
S		2.4	4.8	5.2	2.0		14.5
SW		2.8	9.5	1.0	.4		13.3
W		1.2	8.9	2.0			11.7
NW		2.0	8.9	8.1			19.0
CALM							
TOTAL	1.6	27.4	50.0	16.3	2.0		100.0

MEAN WIND SPEED: 37 KNOTS; DIRECTION: 190 DEG; DAY: 29; HOUR: 18

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 248

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-8.9	>8.9	MEAN	MAX (DA HR)
% FREQUENCY		7.6	30.6	22.6	16.7	19.1	3.6	.4	2.6M	8.0M (18 15)



NOVEMBER 6816 — DATA SUMMARY — AVERAGE LATITUDE 42.5N, AVERAGE LONGITUDE 130.0W

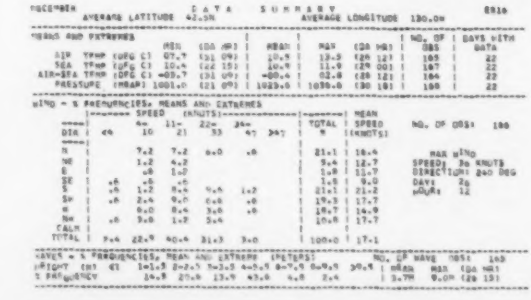
MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	07.7	(16 03)	11.9	14.9	(04 18)	204	26
SEA TEMP (DEG C)	11.0	(22 15)	12.8	14.1	(01 03)	207	26
AIR-SEA TEMP (DEG C)	-05.1	(16 00)	-01.1	01.0	(27 00)	204	26
PRESSURE (MBAR)	0996.1	(09 21)	1019.3	1041.6	(26 18)	170	24

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%		1.9	3.9	.5	.5		9.4
NE		.5		.5			1.0
E		1.0					1.0
SE		1.0	5.4	2.5			8.9
S	.5	1.0	0.9	10.3	.5		17.2
SW		3.0	10.7	1.4	.5		23.2
W	.5	2.9	10.8	0.4			25.6
NW	.5	1.5	9.4	4.9	.5		16.7
CALM							
TOTAL	1.9	13.9	37.1	20.1	2.0		100.0

MEAN WIND SPEED: 34 KNOTS; DIRECTION: 190 DEG; DAY: 15; HOUR: 00



DECEMBER 6816 — DATA SUMMARY — AVERAGE LATITUDE 42.5N, AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	OBS	NO. OF DAYS WITH DATA
AIR TEMP (DEG C)	07.7	(31 09)	10.5	13.5	(26 12)	165	22
SEA TEMP (DEG C)	10.4	(22 15)	10.9	11.9	(29 00)	167	22
AIR-SEA TEMP (DEG C)	-03.7	(31 09)	-00.4	02.8	(09 12)	164	22
PRESSURE (MBAR)	1001.0	(21 09)	1023.0	1039.0	(30 18)	168	22

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	MEAN SPEED (KNOTS)
%		7.2	7.2	0.0	.0		21.1
NE		1.2	4.2				9.4
E		.6	.6				1.8
SE	.6	.6	.0				1.8
S	.6	1.2	8.4	4.8	1.2		21.1
SW	.6	2.4	9.0	0.6	.6		19.3
W		0.0	8.4	3.6	.6		18.7
NW	.6	3.0	1.2	5.4			10.8
CALM							
TOTAL	3.6	22.9	40.4	31.3	3.0		100.0

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS): NO. OF WAVE OBS: 165

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-4.5	5-7.5	8-8.9	>8.9	MEAN	MAX (DA HR)
% FREQUENCY		24.8	27.3	13.9	43.0	4.8	2.4		1.7M	9.0M (29 15)

NOVEMBER D A T A S U M M A R Y 8933
AVERAGE LATITUDE 58.0N AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-00.5	(10 21)	09.4	06.9	(20 21)	183	30
SEA TEMP (DEG C)	05.7	(26 00)	06.8	08.5	(05 13)	170	30
AIR-SEA TEMP (DEG C)	-00.9	(01 00)	-03.1	00.3	(20 21)	170	30
PRESSURE (MBAR)	0980.1	(11 06)	1001.8	1039.0	(29 03)	176	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	1.1	4.0	1.1			6.2	7.2
NE		1.7	4.5	1.1		7.3	14.6
E		1.7	10.2	11.9	.0	24.3	21.0
SE		4.0	5.1	1.1		10.2	12.8
S		9.1	10.2	2.3		17.9	13.9
SW	.0	9.4	9.8			19.2	11.9
W		4.0	14.7	.0		19.2	13.2
NW		1.1	4.5			5.8	13.8
CALM							
TOTAL	1.7	34.9	59.9	16.9	.0	100.0	14.9

NO. OF OBS: 177
MAX WIND SPEED: 34 KNOTS DIRECTION: 100 DEG DAY: 14 HOUR: 21

NOVEMBER D A T A S U M M A R Y 8934
AVERAGE LATITUDE 40.1N AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.1	(28 09)	13.0	17.4	(09 00)	222	30
SEA TEMP (DEG C)	12.8	(30 15)	13.6	15.2	(18 15)	222	30
AIR-SEA TEMP (DEG C)	-00.2	(19 12)	-01.0	02.6	(09 00)	221	30
PRESSURE (MBAR)	0994.9	(13 21)	1019.1	1039.0	(30 00)	221	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	.5	3.2	7.0			11.4	12.2
NE	.9	5.5	.9	2.3		9.6	12.4
E		1.8	1.4			3.2	9.0
SE	.9	1.8	3.7			6.5	11.4
S	.5	4.6	11.4	1.4		18.3	12.8
SW	.9	3.2	13.7			17.8	12.5
W	.9	3.2	11.0	1.4		16.0	14.9
NW	.9	3.2	12.3	3.2		19.2	16.2
CALM							
TOTAL	4.6	28.9	66.7	8.2		100.0	13.4

NO. OF OBS: 219

NOVEMBER D A T A S U M M A R Y 8941
AVERAGE LATITUDE 39.7N AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.4	(19 12)	12.9	18.7	(19 03)	219	30
SEA TEMP (DEG C)	12.5	(30 03)	14.1	16.3	(10 18)	216	30
AIR-SEA TEMP (DEG C)	-00.3	(19 15)	-01.9	03.3	(27 00)	216	30
PRESSURE (MBAR)	0995.0	(13 18)	1020.0	1034.9	(30 00)	199	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	.9	4.7	7.0	1.9		14.6	13.8
NE	.9	3.3	2.8	1.4		8.5	13.1
E	.5	1.9	.5			2.8	7.0
SE	.5	2.3	1.9			4.6	8.8
S	1.4	7.9	12.7	.9		23.0	12.1
SW	.9	4.2	7.0			11.7	10.4
W		2.8	9.4	.9		13.0	13.4
NW	.9	3.3	12.7	4.2		20.7	16.4
CALM							
TOTAL	5.5	30.5	54.5	9.4		100.0	12.9

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 230

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	10.5	MEAN	MAX (DA HR)
% FREQUENCY	29.2	40.0	19.2	3.0	2.5				1.4M	4.0M (20 00)

NOVEMBER D A T A S U M M A R Y 8941
AVERAGE LATITUDE 28.5N AVERAGE LONGITUDE 090.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	08.7	(29 12)	19.7	29.3	(07 19)	199	28
PRESSURE (MBAR)	1011.1	(09 21)	1020.7	1028.0	(29 15)	199	28

NOVEMBER D A T A S U M M A R Y 8944
AVERAGE LATITUDE 20.4N AVERAGE LONGITUDE 090.8W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	18.0	(29 12)	24.7	28.2	(07 21)	234	30
DEWPOINT TEMP (DEG C)	10.3	(14 12)	20.4	24.3	(30 12)	230	30
SEA TEMP (DEG C)	24.9	(25 15)	25.2	27.4	(09 00)	226	30
AIR-SEA TEMP (DEG C)	-07.9	(23 12)	-01.4	01.4	(02 15)	223	30
PRESSURE (MBAR)	1006.0	(29 21)	1015.5	1027.1	(25 15)	239	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	.9	2.1	14.5	6.0	.4	23.9	18.2
NE	1.3	7.7	8.1			17.1	10.4
E	.4	10.3	14.1			24.5	11.6
SE	.9	5.6	11.6	1.3		19.2	13.0
S	.4	2.1	1.7			4.3	10.1
SW	.9	.9				1.3	8.3
W	.4	.9	2.6	.9		4.7	16.4
NW		.4	1.7	2.1	.4	4.7	19.7
CALM							
TOTAL	4.1	29.5	54.3	10.3	.9	100.0	13.6

MAX WIND SPEED: 37 KNOTS DIRECTION: 320 DEG DAY: 22 HOUR: 21

DECEMBER D A T A S U M M A R Y 8933
AVERAGE LATITUDE 58.0N AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-03.6	(05 21)	02.1	06.8	(19 12)	199	31
SEA TEMP (DEG C)	04.7	(23 15)	05.6	08.6	(01 09)	194	31
AIR-SEA TEMP (DEG C)	-00.6	(08 21)	-03.5	01.7	(21 15)	192	31
PRESSURE (MBAR)	0974.7	(20 21)	1002.1	1031.4	(31 03)	197	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	.5	3.1	1.0			4.7	7.9
NE		.0	2.0	3.1		5.2	19.2
E		3.0	19.1	10.6		29.2	18.9
SE		3.0	7.6	3.1	.5	14.1	17.7
S		2.6	7.6	2.1	.5	12.5	18.9
SW		3.0	2.0	.5		5.8	12.1
W		4.2	10.0	3.1		17.2	18.1
NW	.5	4.2	3.6			8.3	9.6
CALM							
TOTAL	1.0	24.9	81.0	22.4	1.0	100.0	16.2

NO. OF OBS: 192
MAX WIND SPEED: 35 KNOTS DIRECTION: 170 DEG DAY: 19 HOUR: 18

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 9.7% SEVERE: NONE OBS: 193

DECEMBER D A T A S U M M A R Y 8934
AVERAGE LATITUDE 40.1N AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-03.8	(24 10)	08.7	13.0	(01 09)	214	31
SEA TEMP (DEG C)	08.7	(30 12)	10.7	12.9	(01 18)	217	31
AIR-SEA TEMP (DEG C)	-10.2	(24 18)	-05.1	03.0	(20 15)	215	31
PRESSURE (MBAR)	1001.4	(10 09)	1019.9	1037.8	(14 00)	210	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	1.4	4.7	9.8	5.7		21.7	15.5
NE		.9	3.2	1.9		6.1	16.8
E	.9	1.9	5.2	1.9		9.4	13.3
SE	.9	3.9	5.2			9.7	11.9
S	.9	.9	6.1	3.3		11.3	16.1
SW		2.8	8.5	.5		11.6	13.8
W		1.4	7.1	.9		9.4	15.0
NW		2.4	11.8	1.4		20.5	16.8
CALM							
TOTAL	3.3	17.0	59.2	20.9		100.0	16.0

MAX WIND SPEED: 32 KNOTS DIRECTION: 340 DEG DAY: 22 HOUR: 21

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 4.6% SEVERE: NONE OBS: 209

DECEMBER D A T A S U M M A R Y 8941
AVERAGE LATITUDE 39.7N AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-03.4	(19 15)	07.3	10.1	(01 13)	221	31
SEA TEMP (DEG C)	10.1	(01 15)	11.7	13.7	(09 13)	220	31
AIR-SEA TEMP (DEG C)	-14.7	(24 13)	-04.4	03.5	(20 13)	220	31
PRESSURE (MBAR)	1002.5	(10 00)	1020.0	1038.7	(15 09)	190	30

WIND - % FREQUENCIES, MEANS AND EXTREMES

	SPEED (KNOTS) 4-	11-	22-	34-		TOTAL %	MEAN SPEED (KNOTS)
DIR	04	10	21	33	47	047	
N	.9	3.7	6.0	5.6		16.2	16.8
NE	.5	3.7	5.1	2.8		11.6	15.0
E		2.3	3.7			5.6	10.4
SE	.9	3.2	2.3	.5		6.9	11.0
S		1.4	6.5	2.8		10.6	16.3
SW	.5	.5	9.3	.9		11.1	15.2
W		.9	6.9	.9		8.8	19.3
NW		2.3	13.5	13.0	.5	29.2	20.5
CALM							
TOTAL	2.3	17.9	53.9	27.3	.9	100.0	16.7

MAX WIND SPEED: 34 KNOTS DIRECTION: 320 DEG DAY: 23 HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 230

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	10.5	MEAN	MAX (DA HR)
% FREQUENCY	0.0	30.4	30.1	11.9	.8				1.7M	4.0M (27 00)

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 3.3% SEVERE: NONE OBS: 213

DECEMBER D A T A S U M M A R Y 8941
AVERAGE LATITUDE 28.5N AVERAGE LONGITUDE 090.8W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	04.9	(19 09)	16.2	23.6	(09 19)	187	23
PRESSURE (MBAR)	1008.3	(25 09)	1022.6	1033.7	(19 13)	110	24

Table 18
Selected Gale and Wave Observations, North Atlantic
November and December 1975

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. (tens of deg)	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb	Temperature °C: Air	Temperature °C: Sea	Sea Waves*: Period sec.	Sea Waves*: Height ft.	Swell Waves: Dir. (tens of deg)	Swell Waves: Period sec.	Swell Waves: Height ft.
NORTH ATLANTIC		NOV.															
EXPORT BANNER	AMERICAN	1	44.0 N	43.1 W	18	29	41	5 NM	15	1010.5	11.3	13.0	8	14.5	27	12	23
PRINCE OF FUNDY	SWEDISH	1	43.7	67.4 W	18	18	41	10 NM	02	1021.9	10.8	10.0	7	13			
AMER ACE	AMERICAN	1	46.0 N	41.5 W	18	27	30	.5 NM	07	1000.0	10.6	17.8			26	10	29.5
NAKAR	NORWEGIAN	2	60.0 N	04.1 W	18	16	49	2 NM	30	997.0	9.0	17.0	9	11.5			
EXPORT FREEDOM	AMERICAN	9	49.2 N	13.5 W	00	32	49	10 NM	02	1014.0	12.3	14.4	5	18			
TILLIE LYKES	AMERICAN	12	38.7 N	43.0 W	00	29	30	10 NM	18	1000.0	15.8	19.4	6	10	29	>13	14.5
OLGA TOPIC	LIBERIAN	14	39.0 N	63.9 W	00	17	41	9 NM	01	1002.0	23.5	23.0	7	14.5			
SEALAND MARKET	AMERICAN	18	49.8 N	05.2 W	00	36	41	10 NM	01	1011.9	8.3	11.1	6	8	05	7	10
GULFQUEEN	AMERICAN	19	33.7 N	42.3 W	00	19	45	5 NM	02	1007.8	24.0	20.6	5	10	XX	X	13
MARSHFIELD	AMERICAN	19	36.8 N	53.7 W	00	34	45	10 NM	01	998.2	17.7	23.3			36	8	11.5
NOPAL FRANCO	NORWEGIAN	20	46.8 N	26.7 W	18	18	48	2 NM	38	1005.0	15.0	18.0					
MARITIME ACE	PANAMANIAN	20	38.7 N	30.1 W	06	29	45	10 NM	02	1006.5	13.0	23.3	5	10	29	9	14.5
NEW HORIZON	LIBERIAN	21	45.7 N	44.1 W	18	28	47	5 NM	03	1008.0	10.0	13.0	5	10.5	29	9	20
SEALAND RESOURCE	AMERICAN	21	45.3 N	40.6 W	06	27	49	10 NM	02	1004.5	3.8	6.7	3	13	27	7	18.5
DUNGA	BRITISH	22	36.7 N	73.9 W	06	29	42	5 NM	02	1009.8	19.5	20.0	4	6.5	29	< 6	13
EXXON WASHINGTON	AMERICAN	23	35.8 N	74.6 W	18	08	45	2 NM	18	1017.3	14.5	23.9			05	< 6	10.5
EXPORT PATRIOT	AMERICAN	24	37.9 N	70.3 W	12	07	45	1 NM	65	1006.4	16.1	18.9	5	14.5	07	7	19.5
SANTA ISABEL	AMERICAN	24	32.8 N	75.1 W	12	31	50	10 NM	80	1008.8	18.7	24.4	4	11.5			
EXPORT FREEDOM	AMERICAN	25	30.3 N	21.6 W	18	27	45	10 NM	02	1025.7	10.0	13.4	4	10	29	8	19.5
LASH ESPANA	AMERICAN	25	41.3 N	38.5 W	15	18	50	1 NM	91	1013.2	20.0	18.3	4	19.5			
LASH ESPANA	AMERICAN	26	41.0 N	39.0 W	00	24	48	9 NM	02	1013.5	20.0	22.3					
BRIGIT MAERSK	DANISH	26	43.5 N	44.3 W	18	22	45	9 NM	05	1022.0	20.0	19.0	6	19.5			
POSSEHL	GERMAN	27	48.5 N	08.2 W	12	27	44	2 NM	29	1009.3	14.5	15.5	9	9.5			
OCEAN STATION VESSELS																	
ATLANTIC M																	
YANEV	AMERICAN	24	38.0 N	71.0 W	09	08	N 44	7 NM	61	1011.8	16.2	18.8	6	14.5			
GREAT LAKES VESSELS																	
MIDDLETOWN	AMERICAN	10	44.5 N	83.2 W	18	24	N 30	9 NM	02		8.8	7.0	9	14.5			
JOHN DYKSTRA	AMERICAN	10	44.5 N	83.2 W	18	24	N 30	10 NM	01		9.0	10.0		14.5			
CASON J CALLOWAY	AMERICAN	10	47.7 N	89.3 W	12	35	N 48	10 NM	23		2.0	4.0		14.5			
PHILIP R CLARKE	AMERICAN	10	47.7 N	87.6 W	06	04	N 42	10 NM	03		1.0	8.0	8	10			
J HUNTON AYERS	AMERICAN	10	46.3 N	83.1 W	18	23	N 46	5 NM	18		9.0	10.0	8	19.5			
CHARLES M BEEGHLY	AMERICAN	10	48.2 N	88.4 W	18	31	N 49	1 NM	72		- 2.0	0.2	5	6.5			
ELTON HOYT II	AMERICAN	11	44.0 N	82.7 W	06	28	N 46	10 NM	01		8.0	10.0	2	6.5			
J L MAUTHE	AMERICAN	11	44.0 N	82.6 W	00	23	N 46	10 NM	02		10.0	10.0	5	13			
JOHN DYKSTRA	AMERICAN	11	45.6 N	83.9 W	00	27	N 34	10 NM	02		9.0	11.0		14.5			
ARTHUR M ANDERSON	AMERICAN	11	47.1 N	83.3 W	00	30	N 30	10 NM	48		1.0	9.0	10	10.5			
JOHN DYKSTRA	AMERICAN	12	47.3 N	90.2 W	12	03	N 48	9 NM	71		- 1.0	9.0		19.5			
J L MAUTHE	AMERICAN	19	48.0 N	89.2 W	18	06	N 41	1 NM	20		0.0	7.0	4	14.5			
FRANK ARMSTRONG	AMERICAN	20	43.8 N	85.5 W	18	08	N 49	2 NM	05		9.0	7.0	5	11.5			
E M HUMPHREY	AMERICAN	23	46.9 N	85.4 W	00	31	N 42	> 25 NM	02		- 3.0	7.0	5	11.5			
J L MAUTHE	AMERICAN	30	42.8 N	86.3 W	06	18	N 48	2 NM			12.0	8.8	5	10			
													5	24.5			
NORTH ATLANTIC		DEC.															
SEALAND PRODUCER	AMERICAN	2	42.8 N	10.1 W	00	25	N 42	10 NM	02	1020.4	13.8	12.7					
SEALAND VENTURE	AMERICAN	2	48.1 N	13.7 W	18	34	N 49	10 NM	01	1020.0	9.4	13.9	8	10	34	9	14.5
SEALAND VENTURE	AMERICAN	3	49.0 N	08.1 W	06	05	N 50	10 NM	02	1021.7	8.9	13.3	7	10	05	8	16.5
SANTA CRUZ	AMERICAN	5	20.9 N	74.1 W	18	06	N 48	5 NM	02	1016.5	27.8	27.0	4	8	06	8	16.5
ELIZABETHPERY	AMERICAN	6	37.6 N	51.6 W	06	34	36	5 NM	18	1007.8	10.0	21.2					
SEALAND CONSUMER	AMERICAN	6	37.2 N	51.1 W	12	36	30	9 NM	02	1007.1	12.6	20.6	6	19.5	36	9	32.5
ELIZABETHPORT	AMERICAN	7	38.9 N	53.2 W	00	30	41	5 NM	18		13.4	21.1	6	14.5			
EXPORT AMBASSADOR	AMERICAN	10	39.7 N	43.6 W	18	02	45	5 NM	02	1008.0	17.7	22.4	6	10	01	9	11.5
EXPORT PATRIOT	AMERICAN	11	43.8 N	62.4 W	06	14	45	9 NM	64	1000.0	3.0	8.3	XX	11.5	14	< 6	14.5
AMCO COMPETITOR	LIBERIAN	11	39.3 N	68.2 W	06	32	44	1 NM	82	1002.0	18.3	23.3		13			
EL YAINO	AMERICAN	13	33.0 N	58.1 W	18	34	45	5 NM	02	1017.6	19.5	21.1	10	10	34	10	36
DOCTOR LYKES	AMERICAN	13	33.8 N	56.0 W	12	02	50	5 NM	50	1013.2	18.1	20.6	10	10	02	8	19.5
E HORNSBY WASSON	BRITISH	13	34.0 N	55.4 W	18	35	N 52	9 NM	15	1016.3	17.0	20.0	9	19.5			
HORNACCAPE	AMERICAN	13	27.7 N	59.3 W	18	34	45	10 NM	01	1011.2	22.2	22.8	8	23			
SEALAND VENTURE	AMERICAN	13	30.1 N	56.9 W	12	33	N 42	9 NM	02	1010.8	18.9	20.1	8	11.5	33	9	16.5
DOCTOR LYKES	AMERICAN	14	32.2 N	59.0 W	00	02	42	5 NM	02	1022.0	17.2	21.7	6	10	36	< 6	16.5
E HORNSBY WASSON	BRITISH	14	34.2 N	55.4 W	00	36	N 50	5 NM	15	1019.6	16.4	20.0	9	19.5			
SEALAND VENTURE	AMERICAN	14	28.9 N	61.3 W	00	36	N 42	10 NM	02	1020.0	19.4	23.9	10	11.5	36	9	19.5
PALSTRIA	AMERICAN	14	44.4 N	41.7 W	00	10	N 52	9 NM	02	1000.9	17.8		7	13	11	>13	13
HORNACCAPE	AMERICAN	14	28.9 N	58.3 W	12	04	45	9 NM	02	1021.4	20.0	23.9	12	23	36	11	16.5
MARSHFIELD	AMERICAN	14	36.0 N	28.1 W	00	11	N 42	5 NM	07	1011.5	18.2	19.5		6.5	10	X	13
PACDUCHESS	LIBERIAN	14	33.4 N	59.3 W	00	33	N 42	.25 NM		1017.0	17.0	23.0	7	23	24	>13	24.5
HORNACCAPE	AMERICAN	16	36.3 N	67.3 W	12	20	39	1 NM	61	1015.2	20.0	23.3	7	11.5	27	7	8
AMER LANCER	AMERICAN	18	44.7 N	61.9 W	18	09	30	.25 NM	69	992.4	2.3	5.0			09	9	18
EXPORT LEADER	AMERICAN	18	40.3 N	62.5 W	12	14	30	2 NM	63	999.0	22.3	22.3	5	8	12	8	14.5
PITTSBURGH	AMERICAN	18	39.7 N	58.4 W	18	18	48	1 NM	68	1009.8	18.9	21.1	8	13			
PURE OIL	AMERICAN	18	27.6 N	69.2 W	18	33	N 42	10 NM	02	1024.4	16.5	23.3	4	10			
AMER LANCER	AMERICAN	19	43.7 N	64.4 W	00	25	30	5 NM	01	993.5	1.0	5.0	8	16.5	10	8	10
SEALAND RESOURCE	AMERICAN	19	47.8 N	47.6 W	12	17	45	1 NM	16	1002.0	0.1	5.0	8	16.5	20	< 6	16.5
EXPORT LEADER	AMERICAN	19	40.3 N	59.6 W	00	22	45	2 NM	81	999.0	19.5	22.2	7	16.5	22	8	19.5
PITTSBURGH	AMERICAN	19	39.5 N	59.6 W	00	18	30	1 NM		1001.0	21.6	21.1	12	19.5	18	10	16.5
BRIGIT MAERSK	DANISH	20	36.1 N	33.0 W	18	09	46	10 NM	03	1021.0	18.0	20.0	5	16.5	08	9	16.5
BRIGIT MAERSK	DANISH	21	36.1 N	32.0 W	12	07	46	10 NM	80	1017.0	17.0	20.0	7	16.5	08	8	21
PURE OIL	AMERICAN	21	27.8 N	68.6 W	06	03	N 42	10 NM	02	1023.7	19.0	23.3	2	8			
SEALAND VENTURE	AMERICAN	22	24.3 N	62.1 W	12	32	N 49	10 NM	03	1018.3	18.9	20.7			34	6	8
W R GRACE	LIBERIAN	23	35.7 N	36.0 W	18	02	45	5 NM	02	1007.5	19.0	18.4	4	14.5	02	8	16.5
ESSO NEW ORLEANS	LIBERIAN	24	36.2 N	35.2 W	00	02	45	5 NM	02	1007.5	19.0	18.0	4	14.5	02	7	16.5
EXXON RANGOR	AMERICAN	26	36.0 N	73.9 W	12	17	N 35	10 NM	15	1013.2	21.2	23.8	3	10			
PAUL POLK	AMERICAN	26	29.0 N	78.3 W	12	18	N 49	10 NM	02	1014.6	22.4	28.7	11	10			
AFRICAN METEOR	AMERICAN	30	31.9 N	61.1 W	12	34	49	9 NM	02	1015.0	17.2	16.8					
BELLA MAERSK	DANISH	31	34.1 N	49.5 W	18	33	41	10 NM	03	1016.5	15.0	18.8	5	14.5	31	6	19.5
SUMAR ISLANDER	AMERICAN	31	34.4 N	38.4 W	12	13	49	2 NM	07	1000.0	17.0		4	13			
								9 NM	21	1000.3	18.4				19	6	8
GREAT LAKES VESSELS																	
CLYDE VICTORY	AMERICAN	1	43.5 N	82.3 W	00	27	N 48	10 NM	01		4.0	7.0	4	8			
FRANK ARMSTRONG	AMERICAN	6	47.5 N	87.3 W	06	36	N 30	> 25 NM	01		- 4.0	4.0	XX	14.5			
ARTHUR M ANDERSON	AMERICAN	13	46.9 N	85.9 W	12	13	N 42	10 NM	02		- 2.0	8.0	5	10			
CASON J CALLOWAY	AMERICAN	13	47.5 N	88.2 W	12	15	N 48	10 NM	02		- 1.0	4.0	4	8			
E M HUMPHREY	AMERICAN	16	48.9 N	91.4 W	12	28	N 49	10 NM	71		-10.0	4.0	4	8			

* Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 33 kn or waves ≥ 23 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Table 19
Selected Gale and Wave Observations, North Pacific
November and December 1975

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH PACIFIC		NOV.															
ASTA BRAVERY	LIBERIAN	1	50.7 N	172.5 E	00	27	N 57	2	NN	991.5	9.0	8.0			27	12	50.5
BELHUDSON	BRITISH	1	51.5 N	166.5 E	00	32	N 47	10	NN	999.0	6.0	6.0	3	10	29	7	16.5
MOBILE	AMERICAN	2	55.4 N	138.9 W	06	23	45	1	NN	969.2	4.4	7.2	10	13	23	12	16.5
EASTERN BUILDER	LIBERIAN	2	57.5 N	162.0 W	12	23	41	5	NN	1010.0	20.0	20.0	7	11.5	23	10	16.5
AVTLA	AMERICAN	3	47.4 N	131.1 W	06	20	30	2	NN	997.2	13.9	10.0	6	14.5			
CHEVRON CALIFORNIA	AMERICAN	3	53.0 N	134.3 W	06	22	N 60	2	NN	996.5	10.0	7.8	2	10	26	< 6	18
LAURITA	NORWEGIAN	3	36.2 N	155.5 E	00	05	36	2	NN	1011.0	16.0	17.0			05	7	26
PHILADELPHIA	AMERICAN	3	51.5 N	131.7 W	06	23	50	1	NN	980.7	11.1	11.1			23	8	24.5
EASTERN BUILDER	LIBERIAN	3	37.3 N	164.2 W	00	32	N 41	10	NN	1015.5	17.0	21.0	9	11.5	32	8	14.5
GRAND CARRIER	LIBERIAN	3	39.1 N	147.3 W	06	23	N 51	2	NN	1006.5	20.0	18.0			XX	X	13
PACIFIC WING	PANAMANIAN	4	34.7 N	147.8 E	18	02	N 50	10	NN	991	19.0	26.0	9	14.5			
GRAND CARRIER	LIBERIAN	4	32.7 N	131.8 W	06	34	N 42	5	NN	1024.0	14.0	22.0			XX	X	16.5
PRES TRUMAN	AMERICAN	5	42.5 N	152.6 W	12	29	50	2	NN	997.0	11.1	12.2	8	16.5			
EATON GLORIA	LIBERIAN	5	39.4 N	157.4 W	06	20	N 42	5	NN	1004.0	16.5	19.0	7	29.5			
GOLDENROD	LIBERIAN	5	47.8 N	141.2 W	18	14	N 60	1	NN	982.5	9.0	9.0	9	46			
ARCO PRUDHOE BAY	AMERICAN	6	43.5 N	128.3 W	12	20	45	2	NN	1005.1	13.2	12.7			20	6	19.5
ARCO SAG RIVER	AMERICAN	6	48.2 N	134.4 W	18	23	60	.5	NN	977.0	9.5	10.0	11	44			
SANSINENA II	AMERICAN	6	51.7 N	132.9 W	06	14	30	5	NN	982.4	8.8	7.7			27	7	8
GOLDENROD	LIBERIAN	6	47.8 N	133.9 W	18	26	N 50	1	NN	980.0	9.5	10.0	9	32.5	18	8	24.5
GOLDEN RAY	LIBERIAN	6	46.6 N	131.2 W	12	22	N 52	2	NN	988.7	9.7	12.0	8	18			
AMER CHIEFTAIN	AMERICAN	7	38.8 N	152.5 E	18	16	45	5	NN	1010.0	18.7	21.5	5	13	16	9	14.5
AUSTIN	AMERICAN	7	47.5 N	125.1 W	00	20	47	10	NN	1000.3	10.6	12.8	9	8	23	9	13
ARCO SAG RIVER	AMERICAN	7	47.7 N	133.3 W	00	24	50	1	NN	979.3	8.2	10.7	10	41	28	>13	57
PACIFIC CARRIER	LIBERIAN	7	41.3 N	124.9 W	00	18	42	2	NN	1021.0	12.8	11.1					
GRAND GLOBE	LIBERIAN	7	48.3 N	130.6 W	00	27	N 45	.9	NN	988.0	10.0	8.0	6	24.5	20	6	24.5
GOLDENROD	LIBERIAN	7	47.6 N	131.7 W	00	26	N 50	2	NN	994.4	10.0	11.0	8	32.5			
HONSHU MARU	JAPANESE	8	44.6 N	151.0 E	00	14	N 42	.5	NN	995.0	11.0	8.0	6	13			
FORT PETTERMAN	AMERICAN	8	54.3 N	147.6 W	12	22	N 45	5	NN	1007.8	2.7	7.8	9	14.5			
VAN ENTERPRISE	LIBERIAN	8	38.0 N	145.1 E	06	27	N 48	5	NN	1004.0	17.0	20.0	6	16.5	27	>13	16.5
AMER CHIEFTAIN	AMERICAN	8	41.3 N	162.0 E	18	18	45	2	NN	1007.0	14.0	14.0			18	8	29.5
FORT PETTERMAN	AMERICAN	9	54.8 N	150.5 W	00	28	45	5	NN	1005.1	3.8	7.8	9	14.5			
CALIFORNIAN	AMERICAN	10	45.3 N	125.2 W	12	36	45	10	NN	999.7	9.5	14.5	6	8			
NEWARK	AMERICAN	11	51.9 N	134.1 W	18	20	45	5	NN	990.9	7.7	7.3	9	13	23	10	24.5
GRAND CARRIER	LIBERIAN	11	38.0 N	162.1 E	18	32	N 53 (1)	1	NN	1006.0	21.0	17.0	XX	19.5	16	X	23
EASTERN BUILDER	LIBERIAN	11	35.3 N	150.3 E	06	36	60 (1)	.25	NN	981.0	19.0	21.0	9	14.5			
SANSINENA II	AMERICAN	11	53.4 N	139.8 W	12	23	45	2	NN	982.1	7.2	6.7	8	11.5	24	10	16.5
PLUVIUS	GERMAN	11	34.3 N	155.4 E	06	17	32 (2)	2	NN	1000.2	23.0	22.0			18	8	24.5
SHUNWIND	LIBERIAN	11	53.6 N	141.2 W	06	23	N 42	5	NN	979.5	6.1	11.0	3	10	24	6	13
AVTLA	AMERICAN	11	50.8 N	136.0 W	18	28	45	2	NN	989.5	7.8	7.8	6	16.5	29	10	16
EASTERN BUILDER	LIBERIAN	12	35.9 N	149.5 E	00	34	N 48 (1)	2	NN	1016.0	15.0	19.0	8	13	36	12	19.5
GRAND CARRIER	LIBERIAN	12	37.2 N	162.9 E	00	20	N 30 (1)	5	NN	1009.0	23.0	16.0					
MAMMOTH PINE	LIBERIAN	12	45.6 N	160.2 E	06	08	N 30 (1)	2	NN	1006.5	5.2	10.0			07	11	21
NEWARK	AMERICAN	12	51.5 N	132.8 W	00	18	45	1	NN	991.5	8.3	8.9	3	14.5	22	8	24.5
AMER CHIEFTAIN	AMERICAN	12	44.5 N	163.0 E	00	29	43	10	NN	1001.0	6.1	10.6	6	19.5			
CARSSINA	PANAMANIAN	13	30.4 N	130.8 W	00	18	N 50	.9	NN	990.0	12.5	10.0	6	16.5			
PHILADELPHIA	AMERICAN	13	30.7 N	130.2 W	00	18	45	1	NN	988.1	11.2	10.0	5	18	XX	X	24.5
NEWARK	AMERICAN	13	48.8 N	125.7 W	18	14	60	1	NN	999.7	11.7	10.0	7	19.5	18	>13	32.5
SANSINENA II	AMERICAN	13	47.5 N	131.9 W	00	18	50	1	NN	995.5	12.2	8.3	8	13	18	10	23
SUMMIT	AMERICAN	14	54.1 N	162.5 W	06	32	50	5	NN	1005.1	- 1.1	0.7	2	6.5			
ARCO PRUDHOE BAY	AMERICAN	14	50.6 N	134.1 W	18	18	45	2	NN	977.8	17.0	7.8	9	13	22	< 6	16.5
SHUNWIND	LIBERIAN	14	54.0 N	163.6 W	06	32	N 44	10	NN	70	1006.9	- 2.1	9.0			32	< 6	10
SINCLAIR TEXAS	AMERICAN	15	52.0 N	138.4 W	12	32	50	5	NN	15	976.0	5.0	6.2	8	19.5			
ARCO PRUDHOE BAY	AMERICAN	15	52.9 N	138.0 W	12	33	55	5	NN	02	981.4	5.0	6.7	5	19.5	35	7	29.5
AMER CHIEFTAIN	AMERICAN	15	42.0 N	132.9 W	00	27	45	10	NN	03	993.2	11.1	13.3	6	23			
TONAMI MARU	JAPANESE	15	51.0 N	158.5 W	06	30	50	5	NN	70	1010.0	0.0	8.0	4	8	30	10	16
RETSHU MARU	JAPANESE	15	48.2 N	128.9 W	12	23	N 50	200	VQ	992.5	8.0	9.5	7	29.5			
CALIFORNIAN	AMERICAN	15	45.3 N	130.3 W	00	18	70	2	NN	64	980.7	11.7	14.0	10	16.5	17	12	19.5
CARSSINA	PANAMANIAN	15	32.7 N	151.6 W	12	28	N 50	5	NN	85	1003.0	0.0	6.0	5	11.5			
JAPAN BEAR	AMERICAN	15	35.7 N	144.5 E	12	16	N 44	10	NN	02	1017.0	21.1	20.6	8	10			
NEWARK	AMERICAN	15	48.7 N	126.2 W	18	23	60	5	NN	82	1001.7	7.7	10.7	6	16.5	23	10	32.5
SHUNWIND	LIBERIAN	16	53.8 N	178.1 E	12	31	N 48	5	NN	03	1003.2	3.8	8.0	4	6.5	31	12	19.5
JAPAN BEAR	AMERICAN	16	36.7 N	150.5 E	00	16	N 42	10	NN	02	1017.5	18.3	21.1	7	11.5			
NEWARK	AMERICAN	16	48.9 N	127.3 W	00	26	40	10	NN	15	1005.4	8.1	9.4	4	10	26	10	32.5
SUMMIT	AMERICAN	17	52.9 N	172.0 W	08	32	45	5	NN	02	997.0	4.5	5.2	5	5	32	6	13
JAPAN BEAR	AMERICAN	17	41.5 N	160.5 E	00	17	N 42	10	NN	02	1016.0	14.5	11.1	6	10			
AVTLA	AMERICAN	18	58.1 N	150.0 W	12	09	47	5	NN	58	1000.0	0.1	8.8	8	13	09	11	18
CALIFORNIAN	AMERICAN	18	34.7 N	142.7 W	00	18	65	2	NN	92	1011.5	18.3	20.9	6	13	18	11	16.5
FORT PETTERMAN	AMERICAN	18	59.3 N	149.7 W	12	02	50	2	NN	62	1003.0	2.7	3.0			XX	X	14.5
JAPAN BEAR	AMERICAN	18	45.3 N	177.0 E	12	27	N 44	10	NN	02	1000.1	0.7	8.9	9	13			
MONTIRON	LIBERIAN	18	43.2 N	178.0 E	00	18	N 45	1	NN	07	1003.1	12.0						
GOLDEN RAY	LIBERIAN	18	46.2 N	138.2 W	12	15	N 45	2	NN	1008.5	10.8	10.0	8	13			
GULDENROD	LIBERIAN	18	32.8 N	142.0 W	18	14	N 60	2	NN	80	998.0	12.5	9.0	9	57			
PHILADELPHIA	AMERICAN	18	34.9 N	140.0 W	06	15	48	2	NN	83	1008.2	8.7	7.2	7	24.5			
NEWARK	AMERICAN	18	36.0 N	145.0 W	06	13	45	5	NN	51	999.7	5.6	8.8	6	16.5	13	8	19.5
VAN CONQUEROR	LIBERIAN	18	30.0 N	139.6 W	12	14	N 50	2	NN	81	994.0	8.0	9.0					
SHUNWIND	LIBERIAN	18	51.5 N	167.9 E	06	32	N 70	1	NN	59	980.0	0.5	9.0			32	>13	32.5
CARSSINA	PANAMANIAN	19	43.1 N	175.2 W	00	28	N 45	5	NN	93	1011.0	2.5	3.6	7	16.5			
JAPAN BEAR	AMERICAN	19	46.2 N	178.5 W	00	28	N 46	10	NN	02	1001.5	0.7	3.6	9	10	25	12	13
MONTIRON	LIBERIAN	19	44.5 N	173.3 W	12	31	N 41	5	NN	27	1008.0	6.0						
PHILADELPHIA	AMERICAN	19	53.5 N	136.8 W	00	14	48	.5	NN	60	1012.3	6.7	7.8	6	24.5	18	X	37.5
PORTLAND	AMERICAN	19	38.4 N	142.5 W	12	14	50	10	NN	02	1005.8	4.5	8.0	6	19.5	14	9	32.5
AVTLA	AMERICAN	19	59.8 N	144.5 W	18	18	50	2	NN	61	1005.3	0.1	4.4	6	19.5	24	9	23
SHUNWIND	LIBERIAN	19	47.0 N	165.4 E	12	21	N 43	5	NN	02	1007.3	0.9	9.0			23	>13	23
CHEVRON FRANKFURT	LIBERIAN	20	17.7 N	135.4 E	12	36	N 46 (3)	2	NN	80	997.0	28.0	29.4	10	28			
BELHUDSON	BRITISH	20	34.4 N	145.2 E	00	31	N 42	10	NN	15	1008.0	17.0	21.0	4	10	30	8	16.5
NORTH STAR III	AMERICAN	20	58.4 N	158.6 W	12	09	N 30	5	NN	21	998.3	5.6	7.2					
MATHILDE MAERSK	DANISH	20	36.6 N	162.0 W	00	32	49	> 25	NN	02	1020.0	10.5		9	21			
SUMMIT	AMERICAN	20	55.8 N	157.8 W	18	08	50	2	NN	65	989.3	2.8	6.7			09	10	10
SHUNWIND	LIBERIAN	20	43.2 N	159.8 E	18	32	N 43	5	NN	03	1002.5	8.7	12.0			32	13	26

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb	Temperature °C		Sea Waves		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 16pt	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 16pt	Period sec.	Height ft.
NORTH PACIFIC OCEAN		NOV.															
CRESSIDA	PANAMANIAN	21	44.2 N	176.5 E	00	N	30	2	NW	1007.0	14.0	11.5	8	14.5			
CHEVRON FRANKFURT	LIBERIAN	21	15.6 N	134.6 E	00	N	40 (J)	2	NW	999.0	25.0	29.4		41			
MONTIRON	LIBERIAN	21	44.9 N	161.5 W	00	N	41	5	NW	1008.0	10.0						
GOLDEN RAY	LIBERIAN	21	42.2 N	153.0 W	06	N	42	5	NW	1009.2	9.0	12.0	6	10	26	11	16.5
SUMMIT	AMERICAN	21	55.8 N	157.8 W	00	W	55	5	NW	994.0	4.5	6.1			12	7	11.5
ROBERTS BANK	LIBERIAN	21	48.2 N	177.0 E	18	W	30	5	NW	986.5	1.3	5.0					
VAN CONQUEROR	LIBERIAN	21	49.9 N	159.4 W	00	N	45	5	NW	990.0	5.0	8.0					
SHUNWIND	LIBERIAN	21	44.7 N	159.0 E	00	N	46	10	NW	1015.0	2.2	12.0			31	>13	23
CRESSIDA	PANAMANIAN	22	43.9 N	172.2 E	00	N	45	10	NW	1016.0	6.5	9.5	7	13			
PIONEER CRUSADER	AMERICAN	22	23.5 N	126.8 E	00	N	45 (J)	5	NW	1013.2	25.5	25.0	6	24.5	02	>13	32.5
GOLDENROD	LIBERIAN	22	53.8 N	175.6 W	18	N	41	10	NW	971.8	3.5	4.0	7	34.5			
ROBERTS BANK	LIBERIAN	22	49.2 N	177.5 W	12	W	50	2	NW	973.4	3.5	4.1	9	11.5	25	>13	19.5
ASTA BRAVERY	LIBERIAN	22	34.8 N	145.9 E	06	N	46	1	NW	1012.0	18.0	25.0	3	10	11	9	14.5
ALBERT MAERSK	DANISH	23	22.5 N	122.8 E	06	N	50 (J)	2	NW	1020.0	20.0		6	16.5	01	>13	19.5
CRESSIDA	PANAMANIAN	23	42.2 N	161.5 E	18	N	50	2	NW	997.0	15.0	10.2	9	8			
PRES PIERCE	AMERICAN	23	41.0 N	178.4 E	06	W	50	5	NW	1010.5	6.7	12.8	6	16.5	32	12	41
SUMMIT	AMERICAN	23	58.9 N	150.5 W	18	W	30	5	NW	990.5	5.5	6.7	8	10			
PLUVIUS	GERMAN	23	34.0 N	177.3 W	18	W	44	5	NW	1012.5	14.0	17.6	3	6.5	34	9	46
VAN CONQUEROR	LIBERIAN	23	49.2 N	172.6 W	12	N	45	2	NW	983.0	4.0	8.0					
GOLDENROD	LIBERIAN	24	53.1 N	172.7 E	18	N	42	.25	NW	975.0	4.0	4.0	8	37.5			
EXPORT CHALLENGER	AMERICAN	24	33.3 N	178.4 W	00	W	42	10	NW	1016.0	15.7	20.0	6	14.5	34	11	23
SUMMIT	AMERICAN	24	58.0 N	150.0 W	00	W	45	5	NW	995.0	6.7	6.2	8	5	09	>13	13
PLUVIUS	GERMAN	24	33.0 N	175.7 W	00	W	44	10	NW	1012.2	15.0	20.5	4	6.5	33	9	32.5
SPERO	NORWEGIAN	24	32.0 N	171.8 W	00	W	44	10	NW	1007.0	13.4	19.0		24.5			
ASTA BRAVERY	LIBERIAN	24	40.0 N	143.0 E	06	N	48	5	NW	1009.5	6.0	17.0	3	14.5	29	7	29.5
THOMAS JEFFERSON	AMERICAN	24	24.4 N	176.6 W	06	W	45	10	NW	1012.5	22.0	26.5	7	11.5			
CRESSIDA	PANAMANIAN	24	41.8 N	158.1 W	06	N	50	2	NW	989.0	5.5	9.0	6	11.5			
HAWAIIAN CITIZEN	AMERICAN	25	28.5 N	151.1 W	12	N	45	5	NW	1017.0	22.8	26.1	4	10			
GOLDENROD	LIBERIAN	25	52.4 N	171.3 E	06	N	43	2	NW	991.0	3.5	4.0	8	37.5			
CRESSIDA	PANAMANIAN	25	38.7 N	150.1 E	18	N	50	5	NW	1014.0	11.0	15.0	4	10	27	10	10
GOLDENROD	LIBERIAN	26	50.4 N	166.4 E	06	N	42	200	YD	1003.3	4.0	4.0	5	11.5	24	8	16.5
AVILA	AMERICAN	27	43.5 N	128.0 W	18	W	45	5	NW	1012.5	9.4	10.6	7	14.5	XX	X	16
VAN ENTERPRISE	LIBERIAN	28	48.9 N	128.7 W	00	N	42	10	NW	1014.0	9.0	9.0	4	14.5	34	13	19.5
AVILA	AMERICAN	28	44.0 N	128.4 W	00	W	45	10	NW	1012.2	11.5	11.7	5	10	33	8	19.5
SUMMIT	AMERICAN	29	53.2 N	170.9 W	06	W	50	5	NW	1007.1	3.9	5.0	9	16.5			
SUMMIT	AMERICAN	30	51.9 N	176.5 W	00	W	35	5	NW	1007.0	3.4	5.0			05	>13	19.5
GOLDEN RAY	LIBERIAN	30	35.8 N	149.1 E	12	N	48	2	NW	1008.4	14.2	20.0	6	10	32	12	8
NORTH PACIFIC		DEC.															
PRES JEFFERSON	AMERICAN	2	46.6 N	176.5 W	12	W	45	10	NW	1008.5	7.8	6.7	4	13			
PRES MCKINLEY	AMERICAN	2	36.8 N	156.8 E	00	W	41	10	NW	1008.7	12.8	17.2	11	24.5			
PRES JEFFERSON	AMERICAN	3	48.1 N	171.8 W	00	W	45	10	NW	1018.7	5.2	5.0					
ZIM TOKYO	GERMAN	3	33.7 N	137.6 W	18	W	47	5	NW	1003.5	14.8	19.0	8	13	30	12	16.5
ASTA BRYAN	LIBERIAN	5	38.0 N	177.9 E	00	N	45	10	NW	1002.0	16.0	19.0	11	19.5	27	12	23
HAWAIIAN CITIZEN	AMERICAN	5	36.1 N	139.2 W	18	W	45	4	NW	1007.0	13.3	19.4	3	11.5	36	7	13
BELMAR	NORWEGIAN	5	51.5 N	167.2 W	21	W	47	.25	NW	999.0	1.0	3.0	7	23			
PRES GRANT	AMERICAN	6	36.3 N	139.8 W	06	W	45	5	NW	1014.2	12.8	18.4	12	24.5			
JAPAN BEAR	AMERICAN	6	34.2 N	176.8 W	18	W	44	> 25	NW	1019.5	14.4	17.8	10	11.5			
HAWAIIAN CITIZEN	AMERICAN	6	35.0 N	140.2 W	00	W	45	10	NW	1011.5	15.6	20.0	3	13	34	8	14.5
NEW ZEALAND BEAR	AMERICAN	6	37.0 N	138.6 W	00	W	45	5	NW	1007.8	12.2	16.7			34	6	16.5
BELMAR	NORWEGIAN	6	51.4 N	168.3 W	00	W	32	.5	NW	997.0	0.5	3.0	10	32.5			
AUSTIN	AMERICAN	6	32.7 N	137.2 W	12	W	50	5	NW	1007.8	16.8	20.5	7	24.5			
POLAR ALASKA	LIBERIAN	6	49.4 N	159.1 E	12	N	46	2	NW	1005.0	3.1	2.0	10	6.5			
WALTER RICE	AMERICAN	7	15.8 N	94.0 W	06	W	50	10	NW	1011.0	28.0	27.5	4	10			
ARCO PRUDHOE BAY	AMERICAN	7	52.9 N	141.3 W	00	W	50	2	NW	985.5	7.0	4.5			23	< 6	14.5
TOYOTA MARU #12	JAPANESE	9	37.9 N	135.2 W	06	N	42	.25	NW	1016.5	13.0	14.5	6	10	03	7	13
JAMARA	NORWEGIAN	13	37.3 N	160.5 E	06	W	50	1	NW	993.0	12.0	17.0	11	32.5			
NYVI OCEANIC	NORWEGIAN	13	36.4 N	165.1 E	00	W	41	5	NW	998.5	18.0		5	10	14	9	19.5
ZIM TOKYO	GERMAN	13	32.7 N	134.2 E	00	W	41	10	NW	1008.0	18.5	20.0	6	5	26	11	6.5
SEALAND COMMERCE	AMERICAN	13	34.5 N	136.5 E	00	W	45	5	NW	1001.5	18.9	18.1	3	10			
PRES PIERCE	AMERICAN	13	34.8 N	161.3 E	03	W	60	5	NW	997.6	17.2	18.3	5	14.5	27	7	24.5
PRESIDENT MADISON	AMERICAN	13	49.3 N	133.0 W	06	W	45	5	NW	1014.2	6.1	5.8	9	19.5	30	>13	31
PLUVIUS	GERMAN	13	34.2 N	160.8 E	18	W	32	10	NW	1009.5	18.2	18.7			27	8	14.5
PRES TAFT	AMERICAN	14	36.0 N	171.0 E	06	W	45	5	NW	1004.7	16.7	17.2	4	6.5	28	8	18
NYVI OCEANIC	NORWEGIAN	14	36.6 N	176.8 E	12	W	45	5	NW	1008.0	13.0	16.0	7	24.5	29	X	36
GALVESTON	AMERICAN	14	55.4 N	142.1 W	06	W	50	2	NW	998.0	2.2	3.0			27	9	19.5
ARCO SAG RIVER	AMERICAN	14	55.5 N	145.1 W	00	W	50	5	NW	991.8	4.0	4.4	6	19.5			
VAN PORT	LIBERIAN	14	51.1 N	169.8 W	06	N	45	5	NW	1003.0	5.0	4.0					
SEALAND FINANCE	AMERICAN	15	39.5 N	178.0 E	00	W	50	5	NW	1002.7	9.5	15.2	10	19.5	28	8	41
POLAR ALASKA	LIBERIAN	15	49.9 N	170.3 E	12	N	34	5	NW	989.0	- 0.1	2.0		26			
IDAHO STANDARD	AMERICAN	16	58.9 N	151.5 W	18	W	45	2	NW	974.5	4.2	6.2	2	8.5	08	< 6	10
POLAR ALASKA	LIBERIAN	16	49.9 N	174.0 E	00	N	51	2	NW	981.0	0.0	2.0		23			
IDAHO STANDARD	AMERICAN	17	58.7 N	149.6 W	03	W	50	5	NW	990.8	3.3	6.7			22	7	13
NYVI OCEANIC	NORWEGIAN	18	37.8 N	134.1 W	12	W	45	.5	NW	1000.3	18.0		10	24.5			
KASHU MARU	JAPANESE	18	42.6 N	156.7 W	18	N	47	1	NW	987.5	8.0	11.0	7	8	22	8	11.5
NEW JERSEY MARU	JAPANESE	18	36.6 N	165.1 W	00	N	45	2	NW	998.0	17.0	18.5	8	13	23	12	23
MUNRO	AMERICAN	19	55.1 N	140.4 W	12	N	45	2	NW	985.5	7.2		9	16.5			
VAN CONQUEROR	LIBERIAN	20	48.2 N	166.2 W	08	N	45	2	NW	982.0	2.0	6.8					
TAIWAN PHOENIX	SINGAPORE	20	48.5 N	164.7 W	00	N	48	1	NW	974.0	3.0	7.0	8	14.5	32	8	11.5
NYVI OCEANIC	NORWEGIAN	20	37.7 N	142.9 W	00	N	45	1	NW	993.8	18.0	15.0		16.5			
PHILADELPHIA	AMERICAN	20	58.0 N	146.2 W	00	N	45	1	NW	982.5	3.0	4.0	5	14.5	18	10	34.5
KASHU MARU	JAPANESE	20	40.7 N	140.2 W	06	N	45	.5	NW	992.5	13.0	16.0	7	10	15	9	16.5
VAN CONQUEROR	LIBERIAN	21	49.5 N	154.1 W	12	N	55	2	NW	987.0	4.0	8.0					
MUNRO	AMERICAN	21	52.2 N	132.2 W	06	N	45	2	NW	1000.8	8.3	9.0	6	10			
PHILADELPHIA	AMERICAN	21	53.9 N	136.1 W	06	N	45	2	NW	994.2	7.2	5.8			11	8	19.5
VAN CONQUEROR	LIBERIAN	22	49.8 N	149.4 W	00	N	50	2	NW	978.0	4.0	8.0					
AMERICA MARU	JAPANESE	23	32.0 N	179.5 W	06	N	45	5	NW	1000.0	18.0	21.0	4	10	24	7	19.5
PRES JEFFERSON	AMERICAN	23	32.3 N	170.1 E	00	N	50	5	NW	1003.4	21.1	20.6	b	19.5			
ASTA BRAVERY	LIBERIAN	23	32.9 N	140.4 W	12	N	42	5	NW	1013.5	19.0	23.0	3	10	24	7	29.5
SEALAND MC LEAN	AMERICAN	24	48.1 N	160.1 W	06	W	45	1	NW	966.5	3.9	4.4	4	8	09	6	14.5
ALBERT MAERSK	DANISH	24	41.2 N	161.3 W	00	N	50	5	NW	978.0	7.0		8	19.5	24	12	23
JAPAN BEAR	AMERICAN	24	21.3 N	121.1 E	00	N	48	10	NW	1020.0	21.1	24.4	8	10			
SEALAND MC LEAN	AMERICAN	25	49.7 N	152.2 W	00	N	45	2	NW	968.0	5.0	5.0	4	10	22	8	19.5
SANSINENA II	AMERICAN	26	30.9 N	136.7 W	18	N	50	2	NW	980.4	6.0	5.4	6	10	27	12	29.5
COLUMBUS CANADA	GERMAN	26	39.6 N	139.5 W	00	N	52	.5	NW	999.0	15.5	15.0	8	29.5	19	9	32.5
SANSINENA II	AMERICAN	27	31.3 N	137.7 W	00	N	45	5	NW	991.5	6.2	5.0	8	14.5	27	10	29.5
COLUMBUS CANADA	GERMAN	27	44.2 N	132.2 W	00	N	44	10	NW	1020.0	11.2	10.0	6	9	27	8	23
MARITIME ACE	PANAMANIAN	28	32.3 N	159.0 E	00	N	50	5	NW	1004.0	10.0	21.0			28	8	11.5
PRES MCKINLEY	AMERICAN	29	47.1 N	167.8 W	06	N	50	2	NW	981.0	9.6	9.6	8	16.5	13	9	23

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb	Temperature °C		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10's	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10's	Period sec.	Height ft.
NORTH PACIFIC OCEAN		DEC.															
GOLDEN BEAR	AMERICAN	29	39.2 N	159.1 W	06	14	N 50	10	NM	02	1019.2	12.2	11.7			17	10	13
OYVI OCEANIC	NORWEGIAN	30	50.1 N	131.8 W	18	32	41	9	NM	15	1028.0	6.0	7.0			32	9	32.5
GOLDEN BEAR	AMERICAN	30	39.8 N	151.9 W	00	16	N 48	10	NM	02	1022.5	11.7	10.6	8	18			
EXXON NEWARK	AMERICAN	30	44.0 N	128.5 W	18	33	N 44	10	NM	15	1039.5	8.5	11.2	6	10			
JAPAN BEAR	AMERICAN	30	34.7 N	146.0 E	18	34	N 45	9	NM	07	1002.5	8.9	10.7	9	10			
MARITIME ACE	PANAMANIAN	30	35.5 N	142.4 E	18	32	N 54	9	NM	07	1010.0	8.0	20.0	8	29.5			
PRES MCKINLEY	AMERICAN	30	48.2 N	161.7 W	00	13	45	2	NM	30	984.8	6.7	5.6	6	16.5			
PUSSEHL	GERMAN	30	37.0 N	143.5 E	18	28	52	9	NM	03	1005.0	9.3	12.0					
ZIM TOKYO	GERMAN	31	34.9 N	178.3 W	12	18	41	2	NM		1000.0	13.2	16.5					
OVERSEAS VALOR?	AMERICAN	31	12.9 N	127.1 E	00	03	45	10	NM	19	1013.9	25.5	27.7	8	13	20	12	16.5
MAMMOTH PINE	LIBERIAN	31	32.9 N	171.6 E	00	20	N 45	2	NM	60	994.0	19.6	20.0	6	6.5	18	9	19.5
JAPAN BEAR	AMERICAN	31	35.0 N	148.2 E	00	29	N 48	9	NM	27	1004.2	7.8	15.6	10	19.5	33	12	23
PRES PIERCE	AMERICAN	31	42.9 N	175.4 W	12	14	45	9	NM	61	993.6	7.8	7.2	5	13			
PLUTOS	GERMAN	31	35.1 N	150.0 E	18	33	44	2	NM	16	1009.0	8.2	13.3	9	14.5	33	10	18
AMER LEGION	AMERICAN	31	34.6 N	156.5 E	06	29	50	10	NM	01	993.9	11.2	13.3			29	< 8	11.5

(I) Typhoon Ida
(J) Supertyphoon June

* Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Rough Log, North Atlantic Weather

February and March 1976

ROUGH LOG, FEBRUARY 1976--The number of low-pressure centers over the shipping lanes was above the average. They tended to form farther north than usual off the U.S. East Coast. The mean track would be from the approximate coordinates of 42°N, 60°W, to 47°N, 40°W, to 53°N, 30°W, where the track split, half tracking toward the southeast coast of Greenland and the remainder moving over Iceland into the Norwegian Sea. There were three storms in the vicinity of the Azores Islands and the usual Mediterranean Sea storms. Across the United States and Canada the track was farther south, converging out of the south central plains and northern plains over southern Michigan and then tracking up the St. Lawrence River Valley. Many dissipated, but others continued over Newfoundland into the main storm stream. Two moved north into the Labrador Sea.

The mean monthly sea-level pressure pattern was near normal in outline, but the pressures differed greatly. The Icelandic Low was 987 mb versus the 1003 normal near 62°N, 35°W. The Azores High was 1027 mb versus 1020 mb and located at 30°N, 40°W, 10° longitude west of its normal position. There was an anomalous closed HIGH over western Russia. The pressure over the United States was near normal, but slightly lower over the north central area.

The major negative anomaly surrounded Greenland with several centers. The deepest was 19 mb near the North Pole with a trough paralleling the eastern coast of Greenland to a 17-mb center near 62°N, 35°W, the location of the Icelandic Low. A positive 9-mb center was near 35°N, 40°W, in conjunction with the Azores High. Another large positive 14-mb center was near Kiev (52°N, 30°E).

The upper-air pattern differed mainly with climatology in height. The major circulation at 700 mb was centered over Baffin Island. As with the surface, it was lower than normal. The anomalous HIGH over Russia was reflected at 700 mb resulting in a ridge over Scandinavia rather than a trough. A slight ridging that is normally west of Europe was displaced by cyclonic curvature.

Extratropical Cyclones--On the last day of January there were several isolated pressure centers south of Nova Scotia. By February 1, they had consolidated, and a 986-mb LOW was southeast of St. Johns. At 1200, the LOW was 974 mb near 51°N, 40°W (fig. 42). The CAROLA REITH (47°N, 39°W) and the ATLANTIC CHAMPAGNE (46.6°N, 37.7°W) were both ravaged by 60-kn winds. The REITH was fighting 49-ft seas. A short distance away the CHAMPAGNE contended with only 26-ft waves. Two ships, one being the OSSENDRECHT, had 55-kn winds. There were gales reported in all quadrants.

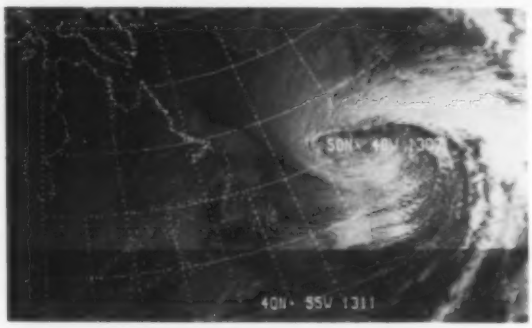


Figure 42.--This satellite image verified the surface analysis location of the storm. Sea ice can be seen off the Labrador Coast.

At 0000 on the 2d, the winds were still roaring south and southwest of the center. The REITH was still reporting 60 kn when the storm overtook the C. P. VOYAGEUR with 60-kn winds and 26-ft waves. At 1200, the LOW was 980 mb near 50°N, 27°W. Three more ships were added to the 60-kn club--the HAHNENTOR, GELA, and SPRUCEBANK. The ATLANTIC CHAMPAGNE (48°N, 36°W) had 65-kn winds with waves decreasing to 38 ft. The GELA (46°N, 24°W) had 65-kn winds and 52-ft waves.

The storm had turned southeastward by the 3d with the JAMAICA PRODUCER reporting 33-ft swells 300 mi southwest of the center. At 1200, the PRESIDENT MONROE, near 42°N, 26°W, had 45-kn winds, and the swells were a devastating 39 ft. The storm continued its southeastward track, and at 1200 on the 4th, the BOOKER VIKING found the same 45-kn and 39-ft wind and swell area. The Canary Islands measured 45-kn winds. Late on the 4th, the storm turned eastward and went ashore over Cabo de Sao Vicente.

Monster of the Month--This storm preferred the coast lines. It moved eastward along the Gulf Coast on the 1st and reached the East Coast on the 2d. At 0000, the EB15 measured 40-kn winds off South Carolina. It raced up the East Coast deepening explosively (fig. 43). At 0000 on the 2d, it was 986 mb over the Carolinas. By 1200, it was 960 mb near Portland, Maine. About 0600, a 2,995-ton Japanese freighter went aground in high winds at Searsport, Maine (fig. 44). She was finally freed on the 15th. The winds forced a barge aground in Chesapeake Bay, and it sank, on the 1st, spilling thousands of gallons of crude oil.

Figure 43.--At 1700, the LOW is over New Brunswick. The sharp frontal boundary and the cumulus clouds behind it give an indication of the storm's intensity and the turbulent conditions.

At sea, the highest wind on the chart was 50 kn by the CG101 south of Cape Sable. Five ships and EB15 reported 40-kn winds, including the USCGC EVERGREEN. Ocean Weather Station Hotel measured 28-ft seas.

By 1200 on the 3d, the 948-mb LOW had raced to near Hebron, Labrador. The N. B. MCLEAN at Anticosti Island and the CRYOS, near 52°N, 51°W, both reported 45-kn gales. On the 4th, other ships in the vicinity of Newfoundland were still reporting 40 kn. The LOW continued across the Labrador Sea and died on the 6th.

This storm system formed as a trough and moved off the coast of Nova Scotia on the 5th. By 1200, the MANCHESTER VIGOUR was receiving 45-kn winds ahead of the cold front. At 0000, the 978-mb storm was at 49°N, 39°W. The DART ATLANTIC (46°N, 35°W) and the NINA KUKOVEROVA (45°N, 39°W) found 50-kn winds. The HECTOR (43°N, 43°W) was sailing into 45-kn gales and 25-ft waves.

At 1200 on the 6th (fig. 45), high wind reports were numerous. Ocean Weather Station Charlie had either 55- or 65-kn winds. The DART ATLANTIC was now fighting 65-kn hurricane-force winds and 33-ft waves. The WESER EXPRESS had 60-kn winds, but swells only picked up to 20 ft. The following ships had 40- to 55-

Figure 44.--The 362-ft Japanese freighter MUSASHINO MARU is hard aground on the rocky Maine beach near Searsport. There was no danger to the crew of 22. Wide World Photo.

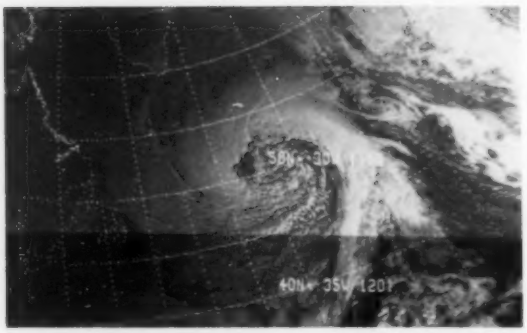


Figure 45.--The satellite passed over the storm center only 2 min off the synoptic hour. There appears to be a micro-circulation not reflected at the surface near 50°N, 17°W.

kn winds: AMERICAN ACCORD, AMERICAN ALLIANCE, MOSEL EXPRESS, NEW ENGLAND HUNTER, and NORAMAR. The ACCORD appeared to have 41-ft seas.

The storm turned northward on the 7th. The DART ATLANTIC was still battling 50-kn winds and 36-ft swell, near 45°N, 36°W, as she slowly progressed westward. The central pressure was down to 942 mb at 0000 near 57°N, 34°W. By 0000 on the 8th, pressure had risen to 954 mb off the southeast coast of Greenland. On the 9th, only a trough remained.

This storm formed over the Dakotas and moved across the Great Lakes on the 15th. At 1200 on the 16th, it was 994 mb over Prince Edward Island. The VGBZ, south of Sable Island, measured 50-kn winds. The storm moved off Newfoundland and was 978 mb, near 51°N, 42°W, at 1200 on the 17th. The WAARDRECHT, near 46°N, 38°W, ahead of the occlusion had 60-kn winds and 33-ft waves on her starboard side. At 0000 on the 18th, the ATLANTIC CROWN had 50-kn winds near 46°N, 40°W. At 1200, Ocean Weather Station Charlie suffered through 50-kn winds and 28-ft seas.

This LOW turned northward late on the 18th and was 956 mb at 0000 on the 19th. The SLETTBAKUR had 60-kn winds south of the Denmark Strait. Ocean Weather Station Charlie was still riding 26-ft waves. At 0000 on the 20th, the LOW was pounding against the coast of Greenland and losing strength rapidly. By 1200, it had combined with the following storm.

A minor trough in the upper air raced across the northern states on the 17th. As the associated surface LOW approached the East Coast, a frontal wave formed ahead of it over the water. Within 12 hr, it was the primary system.

At 0000 on the 18th, the LAURENTIAN FOREST (42°N, 56°W) was only 60 mi north of the apex of the wave with 45-kn gales. The 1200 chart showed only one circulation at 990 mb, as the previously described LOW moved northward. At 0000 on the 19th, the LOW was 981 mb near 43°N, 34°W. The HECTOR, at 41°N, 39°W, was headed northward into 65-kn northerly winds. No seas were given. This LOW moved farther eastward before turning northward like its predecessor. At 1200, the WESERMUNDE reported 50-kn winds and waves to 26 ft in the southwest quadrant, while the ANTON DOHRN contended with 45-kn gales on her starboard bow in the northeast quadrant. At 0000 on the 20th, Ocean Weather Station Lima was 120 mi northeast of the 965-mb center with 50-kn southeasterly winds and 23-ft seas. Gales were blowing on both sides of the cold front which stretched southward to 35°N before curving southwestward.

By 1200 on the 20th, this LOW and the previous LOW had combined at 962 mb near 63°N, 29°W. Only minor gales were recorded. The LOW curved southward along the Greenland Coast to disappear near Kap Farvel.

This storm came out of the southern Canadian Plains and moved across Ontario and Quebec Provinces. At 0000 on the 28th, it started affecting shipping as it entered the Gulf of St. Lawrence at 992 mb. The water had an immediate effect, and the storm deepened to 978 mb by 1200. As the center approached the Strait of Belle Isle, it curved northward. At 0000 on the 29th, the DON JOSE was near 53.5°N, 45°W, with 40-kn gales. The HUDSON was north of Hamilton Inlet very near the 960-mb center with only 30-kn winds; 12 hr later, things had changed as the LOW moved north of her position. At 1200, 60-kn winds were roaring out of the west with heavy snow. Thirty-five- and 40-kn winds were blowing as far south as 40°N. The DON JOSE now had 20-ft seas. At 0000 on March 1, the HUDSON still had 55-kn winds which slowly slackened to 45 kn by 1200, which held until the 3d. By that time, the coast of Greenland had taken another toll.

Casualties--The British-registered 18,744-ton R. A. EMERSON was hove to, while 1,600 mi southeast of Halifax, on the 2d, due to damage by heavy seas. It was reported, on the 5th, that the 8,784-ton Norwegian TURANDOT had damage from heavy seas to deck cargo of chlorine gas. Poisonous fumes injured two crew members.

The Greek-registered GOOD VENTURE (12,149 tons) arrived Sydney with ice damage. The American EAGLE COURIER (16,443 tons) arrived Netherlands with alleged ice damage which occurred on the 24th.

The 37,783-ton Netherlands cruise ship ROTTERDAM encountered a freak wave estimated to be 60 to 98 ft (18 to 30 m) high off Casablanca that severely rolled the ship. No date was available.

ROUGH LOG, MARCH 1976--The storm paths along the Great Lakes-St. Lawrence River trade route were near normal. Those cyclones that formed off the U.S. East Coast formed farther east than usual, moved northeastward, and then turned northward toward Iceland near midocean. The storms moving out of the Gulf of St. Lawrence curved toward Kap Farvel and the Denmark Strait. During the second week of the month, one storm managed to track from South Carolina to France. There were two significant cyclones over the Mediterranean Sea.

The overall pressure pattern was near normal, except that a sublow of the Icelandic Low normally near Nordkapp was missing. The major pressure

centers were more intense and slightly misplaced. The Icelandic Low was 987 mb and centered near 62°N, 35°W, versus 1005 mb near 58°N, 40°W, according to climatology. The Azores High was 1027 mb near 32°N, 40°W, versus 1020 mb near 26°N, 36°W. A high-pressure center over Germany was 6 mb higher than normal at 1022 mb.

The pressure was above normal over the ocean south of 50°N from the eastern United States to Europe where the zero deviation line turned northward to Spitzbergen and then to eastern Siberia. A large positive 11-mb anomaly covered the central North Atlantic from 50° to 15°N. Another large positive 18-mb anomaly was centered east of the Ural Mountains. There was a 7-mb subcenter over Denmark. The significant negative anomaly was 18 mb near 63°N, 33°W, reflecting the Icelandic Low.

The major difference in the 700-mb upper-air pattern was a shifting of the primary and a secondary LOW. The primary center of circulation normally over the Arctic Ocean near the U.S.S.R. was shifted to northern Baffin Island where a subcenter is normally located. The subcenter then moved southeastward near the surface Icelandic Low. This resulted in the movement of the major trough from off the U.S. East Coast to the central ocean.

Extratropical Cyclones--The first major marine storm in the North Atlantic this month originated in the Midwest on the 4th. It tracked over the Great Lakes on its way to the Strait of Belle Isle, at 1200 on the 6th, at 980 mb. Gales were blowing off the New England Coast. On the 7th, a second LOW developed in the circulation off Hopedale. Kap Farvel reported 40-kn winds. At 0000 on the 8th, they had increased to 55 kn. The second LOW was developing into the primary circulation center at 965 mb.

Very few ships were reporting in the area of the storm. At 1200 on the 9th, Ocean Weather Station Lima measured 40-kn winds and 16-ft waves. The second LOW remained essentially stationary over the Labrador Sea, but it started moving eastward late on the 9th. At 1200 on the 10th, the HUDSON, at 55°N, 51°W, was bounced by 55-kn winds and seas to 21 ft. Late on the 10th, the 963-mb LOW turned toward the southeast coast of Greenland. A coastal station near 67.5°N reported 55-kn winds off the sea. The storm turned southward along the coast and dissipated on the 12th.

The 11th was a good day for starting storms. This one started as a wave on a cold front southeast of Newfoundland. The KAI was south of the wave with 45-kn winds. The wave was racing along under strong zonal flow. The NEW ENGLAND HUNTER was treated to 45-kn gales as the storm raced by to the north. The ATLANTIC SONG finished much closer to the 998-mb center with 40-kn winds.

The center was nearing the Irish Coast on the 12th. OWS Romeo measured 40-kn winds and 26-ft seas. It was not until the storm was near the Irish Coast that it deepened and increased its circulation. At 1200 on the 12th, the LOW was 964 mb near Cork. Ocean Weather Station Romeo now had 45-kn winds and 39-ft seas. Other ships had 40-kn winds, but none reported seas. On the 13th, a Soviet ship off Havre had 45-kn winds and 20-ft seas. The LOW crossed the coast of France on the 13th.

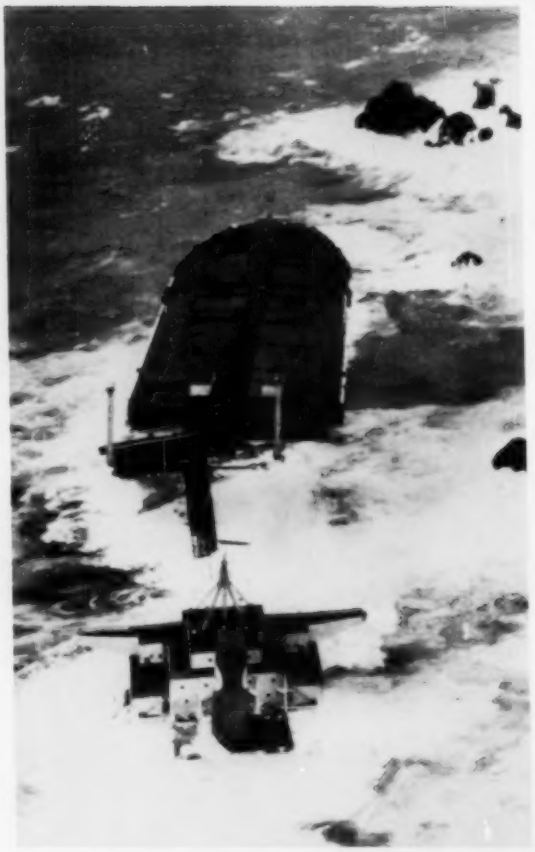


Figure 46.--The sea and rocks were finally victorious over the supertanker OLYMPIC BRAVERY. All attempts to free her failed, and she broke up during this violent gale. Wide World Photo.

During this storm the 250,000-ton OLYMPIC BRAVERY, which went aground on January 24, broke in two (fig. 46). The tanker was aground on the rocks at Ushant Island. All efforts to free the ship had been unsuccessful.

This was one of the LOWs that developed off the U.S. East Coast. It formed as a wave on the same cold front as the previous storm, on the 11th, and moved northward. By 1200 on the 12th, it was 982 mb near 45°N, 53°W. The drilling rig VGBZ, south of Sable Island, measured 60-kn winds, but the waves had not built beyond 10 ft. The HECTOR, more south of the center, near 41°N, 58°W, was sailing into 50-kn winds and waves to 20 ft. Even farther south, the CAP SAN ANTONIO (38°N, 55°W) was cruising into 40-kn winds, but the seas were 26 ft.

The 974-mb LOW was near 48°N, 46°W, at 0000 on the 13th. A SHIP east of Halifax logged 55-kn winds. The FRITHJOF (51°N, 50°W) and the PHILOSOPHER

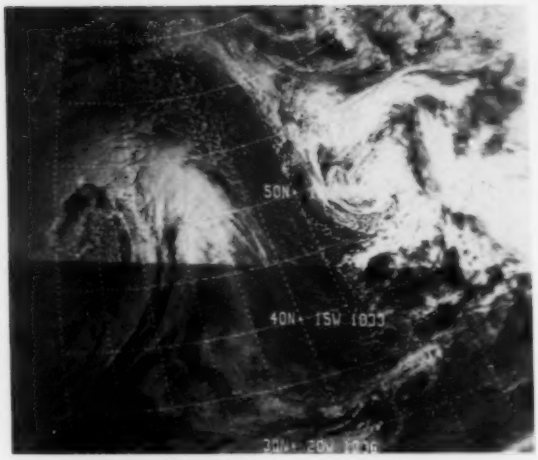


Figure 47.--Two violent storms are captured in this picture. This storm is on the left in the twilight area. The storm that broke up the OLYMPIC BRAVERY is centered over the Brest Peninsula.

(42°N, 54°W) fought 50-kn winds with the latter having 26-ft waves. Twelve hours later, the 960-mb LOW was tightly wound near 53°N, 37°W (fig. 47). The CAST BEAVER, near 44.5°N, 45°W, had 55-kn winds and 30-ft seas and swells on her port side. The LOW reached its minimum pressure of 956 mb at 0000 on the 14th. The CAROLA REITH caught the brunt of it with 65-kn winds near 48.5°N, 33°W. The seas were 25 ft, and the swells were 46 ft. To the south, at 45°N, 33°W, the TSUGARU MARU had lighter, 45-kn winds and 33-ft swells. As the CAROLA REITH moved west for the next 12 hr, the winds decreased to 45 kn and the waves to 31 ft. Ocean Weather Station Charlie reported 23-ft waves, and Romeo had 30 ft. As the LOW passed Lima, it was weakening rapidly, and on the 15th it was gone.

This LOW can be traced back to the 5th in the mid-North Pacific. It crossed the coast of British Columbia on the 10th and the Great Lakes on the 13th (fig. 48). The circulation was diffuse as it crossed the Rocky Mountains, but it consolidated over the Great Plains into a large 992-mb storm. Storm warnings were issued for Lakes Superior, Erie, and Michigan for winds to 50 kn. On Lake Superior, 12-ft waves pounded the shore. On Lake Michigan, waves up to 10 ft flooded low areas and eroded the eastern shore. The storm did not deepen significantly until it moved over the open water. At 1200 on the 14th, it was 970 mb over Notre Dame Bay. At that time a ship that appeared to be the ANTON DOHRN fought 45-kn gales off St. Johns. Ahead of the cold front, the MUENCHEN, near 42°N, 53°W, found 40-kn gales with 16-ft seas and 33-ft swells. The MARIE LEONHARDT at the cold front (40.5°N, 58°W) had 30-kn gales, 20-ft seas, and 26-ft swells. At 0000 on the 15th, the 960-mb LOW was near 53°N, 45°W, and the DART AMERICA was treated to 45 kn.

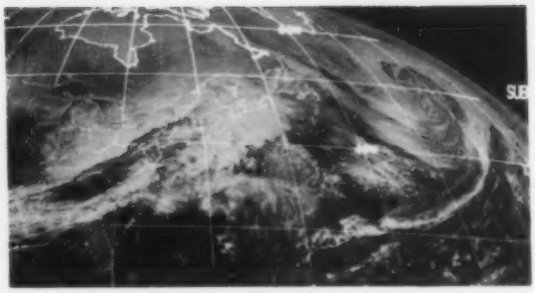


Figure 48.--The center of the storm is located near Montreal at this time. The clouds have cleared over Lake Superior, clearing has started over Lakes Huron and Michigan, and the winds have started to abate by 1600. On the right is an oblique view of the storm over the Atlantic. The storm over the Brest Peninsula is beyond the horizon.

Later on the 15th, the LOW turned northward at 952 mb, and at 1200 Ocean Weather Station Charlie measured 60-kn winds with 30-ft seas. This was the deepest pressure the LOW attained. At 0000 on the 16th, a weather station on the ice cap of Greenland reported 55-kn winds with -14°C. The LOW was pounding the fjords of Greenland, at 1200, and the circulation was rapidly contracting, but the ANNA WESCH reported 40-kn winds, 16-ft seas, and 41-ft swells near 56.5°N, 32°W. Early on the 17th, the storm was a small, tightly wound center on the coast of Greenland, and it dissipated completely by the 18th.

Monster of the Month--This storm moved out of New Mexico as a frontal wave. It did not develop until late on the 16th as it approached the U.S. East Coast. By 1200 on the 17th, it was 962 mb near Yarmouth, Nova Scotia. On the afternoon of the 16th, storm warnings were issued for the New England Coast with hurricane-force winds in the Narragansett Bay area (fig. 49). Up to 14 in of new snow accumulated in some areas of Maine, with 20 in in northern Maine. Boon Island, along the coast of Maine, reported gusts to 75 mph. The highest ship-reported wind at synoptic time was 40 kn at 1200 off Cape Cod.

At 0000 on the 18th, the 957-mb LOW was near Corner Brook, Newfoundland. Four ships reported 40-kn winds from Cape Cod northward. St. Pierre measured 60-kn winds. A ship at 51°N, 50°W, reported 60-kn winds just prior to passage of the occlusion. The ATLANTIC CHAMPAGNE, at 40°N, 51°W, and east of the cold front, was tossed by 20-ft seas and 28-ft swells. At 0000 on the 19th, the center was approaching Kap Farvel with a pressure of 952 mb. Ocean Weather Station Charlie measured 50-kn winds and 26-ft seas. Waves were forming on the front south of the center and moving northeastward around the perimeter. Forty knots was the strongest wind on the chart, but the ANNA WESCH reported 33-ft swells near 50°N, 42°W.

As the storm moved across the southern tip of

Figure 49.--The sea can be relentless as this picture and figures 44 and 46 indicate. The high waves have gradually but surely eroded the beach at Plum Island allowing the houses to topple, as this one did during this storm. Wide World Photo.

Figure 50.--One of the old centers can be seen off the east coast of Greenland. The new center, packing 70-kn winds, was near 53°N, 23°W, at this time on the 20th.

Greenland, the LOW split, and a center moved northward along each coast. The primary center stalled near 63°N until dissipating on the 22d. On the 20th, one of the frontal waves developed into full-blown cyclone. At 1200, its central pressure was 952 mb at 56°N, 24°W (fig. 50). The MAMMOTH PINE, 160 mi south of the center, was blasted by 70-kn winds and seas to 23 ft. Another ship much farther south had 45-kn winds, 16-ft seas, and 26-ft swells. OWS Lima measured 40-kn, at 0000 on the 21st, with 20-ft seas and monstrous 39-ft swells.

This center was rapidly moving northward treating Iceland to gales as high as 45 kn as it passed along the western coast to dissipate on the 22d.

On the 1200 chart of the 21st, another wave had formed on the front over the Bay of Biscay. Ocean Weather Station Romeo reported 30-kn winds from the north and 20-ft seas. By 0000 on the 22d, the 1000-mb LOW was over the Brest Peninsula. The 4,796-ton Liberian SCOL PROMINENT developed a leak due to shifting cargo while off Bordeaux, France. The 11,859-ton REA sustained hull damage while berthed at La Palisse, France, due to strong winds. The LOW then moved across Europe.

A complex frontal system was moving across the eastern United States and Canada on the 21st and 22d. The front was associated with a very sharp trough

without a well-defined LOW. On the 21st, two frontal systems were approaching the East Coast. The first front moved over Baltimore's Dundalk Marine Terminal about 2000. A wind estimated at 78 kn suddenly hit the waterfront and two container cranes were wrecked and fell into the water; two others were damaged. Two workers were killed. Cargo sheds, containers and vehicles were also damaged. The falling cranes damaged the superstructures of the AMERICAN LEGION and the ALBERT MAERSK. On the 1200 chart of the 22d, a small LOW had formed near Belle Isle, Labrador. It raced northeastward past Kap Farvel by 0000 on the 23d. At 1200, the 950-mb LOW was near 65°N, 36°W. The BAMSA DAN, at 60°N, 28°W, had 45-kn gales and 16-ft waves. At 1200 on the 24th, the BAMSA DAN logged 50-kn winds with the seas still 16 ft. The ice cap station had been logging 40- to 50-kn winds for 48 hr.

Twelve hours later, at 0000 on the 25th, the ship, still in the same vicinity, logged 50 kn and 30-ft swells. By 1200, the high swells had moved to the vicinity of OWS Lima which measured 36-ft swells with 45-kn winds. The LOW was moving through the Denmark Strait on the 26th at 968 mb. Back in the vicinity of 60°N, 33°W, a ship, probably the BAMSA DAN, radioed 50-kn winds and 33-ft seas. Lima now had 21-ft waves. The high waves of about 20 ft now extended at least from Charlie to Lima. At 1200 on the 27th, another low center formed south of the Denmark Strait tightening the gradient. Lima again measured 50-kn winds and 30-ft seas. As both LOWs moved northeastward, only the two Ocean Weather Stations were reporting that far north, at 0000 on the 28th. Lima continued to have 45-kn gales and 33-ft seas. The LOW finally moved out of the area of primary interest on the 28th.

Casualties--The American-registered 15,200-ton EL TAINO was blown against a bank due to high winds while making fast to mooring buoys at Port Said on the 7th. The 6,178-ton Greek EVGENIA I ran aground on a reef in the Red Sea on February 11 and then was beached. On March 15, the vessel shifted during high winds and developed a 15 degree list. The Yugoslavian bulkcarrier SKRADIN (12,275 tons) arrived at Baie Comeau, Quebec, with ice damage. The 16,450-ton REGAL SWORD sustained ice damage to propeller blade tips on the 15th. Temporary repairs were made at Halifax.

Rough Log, North Pacific Weather

February and March 1976

ROUGH LOG, FEBRUARY 1976--There were three major storm tracks this month, all slightly different from their climatological counterparts. The first was from along the southern coast of Japan and curved northward toward the Kamchatka Peninsula. The second, from approximately 35°N, 155°E, curved northeastward to the Alaska Peninsula. The third was from near 35°N, 160°W, to Sitka. The number of storm centers was near normal.

Climatically, the Aleutian Low has three centers, the two deeper ones over the western ocean and a third over the Gulf of Alaska. This month there were four centers with the deepest two (1005 mb) over the eastern ocean. In this case, "deep" is relative as none of the four were as intense as climatology indicates. The fourth LOW was over the Sea of Okhotsk. The Pacific High at 1024 mb was 4-mb higher than normal and about 10° longitude to the east.

In general, all of the North Pacific north of 25°N was above normal in pressure. There was one large positive anomaly from coast to coast with a 9-mb center. An 8-mb subcenter was over eastern Siberia. The two small negative centers were not over the shipping lanes. A negative 5-mb center was centered over the northern Sea of Okhotsk, and a small 3-mb center was near Sitka, Alaska.

The upper-air zonal flow between 30° and 50°N was normal. A closed center at 700 mb over Kamchatka was replaced by only a trough farther west over the Sea of Okhotsk. A shallow anomalous trough was over the Alaska Peninsula displacing the normal ridge westward.

There was one tropical storm, Lorna, near the end of the month.

Extratropical Cyclones--This LOW formed south of Kyushu in conjunction with frontogenesis. It was a 992-mb center after passing south of Tokyo on the 5th. At 0000 on the 6th, the SHINTO MARU was 200 mi south of the LOW with 45-kn gales. By 0000 on the 7th, the 956-mb center, near 45°N, 160°E, had a circulation which covered the western third of the ocean (fig. 51). The BARON RENFREW, at 40°N, 174°E, had 60-kn

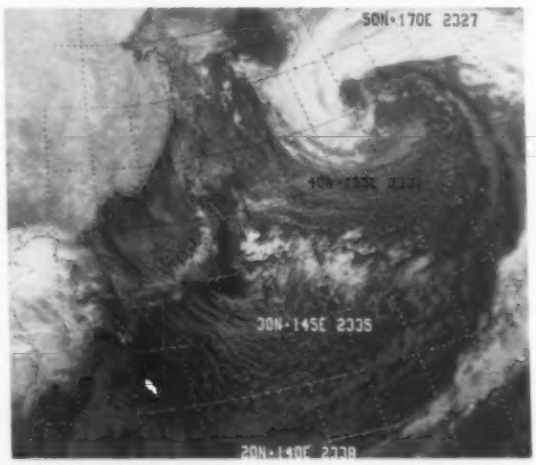


Figure 51.--The cloud streaks indicate the cyclonic circulation penetrates as far south as latitude 20°N.

southerly winds east of the occlusion. The seas were 20 ft and the swells 26 ft. The SANYU MARU was north of the center with 50-kn winds, and another ship was 500 mi to the south with 50 kn and 23-ft swells. There were five reports of 50-kn winds north and west of the center, two of which were island measurements. The EUROPEAN HIGHWAY (52°N, 165°E) had 50-kn winds and 23-ft seas. The AKAISHI MARU, near 47°N, 156°E, had only 40-kn gales, but the swells were 33 ft. Far to the south, the KOWLOON BAY, near 35°N, 150°E, had 30-ft swells with 20-ft seas.

On the 8th and 9th, the LOW was stationary near 49°N, 166°E. Gale-force winds continued to blow in all quadrants. The LOW started moving eastward again on the 10th, but it was deteriorating in intensity as minor Lows formed in the southeast quadrant. The last significant report was by the ROKKOHSAN MARU, at 0000 on the 11th, with 40-kn winds and 23-ft seas.

This storm formed in an area of weak pressure gradient east of Tokyo on the 11th. It quickly changed that situation with a well-developed circulation. By 0000 on the 12th, the 984-mb LOW was near 39°N, 157°E. The ST. LOUIS MARU was near 37.5°N, 156°E, with 55-kn storm winds and 20-ft seas and swells. Twelve hours later, the NICHIWA MARU (33°N, 149°E) radioed 45-kn winds and 31-ft swells. The strongest winds continued in the western quadrant as the storm moved slowly eastward for this latitude.

By 1200 on the 13th, the strong wind band appeared to have shifted to the southern quadrant. The SEIZAN MARU found 55-kn winds at 34°N, 166°E, and about 100 mi to the southeast the YAMASHIN MARU was tossed by 40-kn winds and 33-ft swells. On the 14th, another LOW developed northeast of the original one. The HERMINA (34°N, 164°E) sailed into 45-kn gales and 33-ft swells. On the 14th, the original LOW disappeared.

A front stretched across Japan from near Tokyo to the East China Sea. Several stable waves formed and dissipated prior to the formation of an unstable wave east of Tokyo on the 16th. This wave moved eastward and expanded. The HERMINA, still headed toward Japan, was at 35°N, 150°E, with 45-kn winds, 16-ft seas, and 33-ft swells pounding her port side. The frontal wave was racing eastward under the long wave zonal flow which was far out of phase. The wave length was especially long with the major troughs inland of both coasts.

It was not until the 18th that the LOW started to deepen significantly and only gales were reported. By 1200, the pressure had dropped to 980 mb near 49°N, 173°W (fig. 52). The HOYO MARU, near 46°N, 176°W, was sailing with 55-kn winds, 33-ft seas, and 46-ft swells on her stern. Twelve hours later at 0000 on the 19th, the pressure had dropped 5 more mb. The VAN FORT, near 50°N, 168°W, fought 60-kn winds, while the DAIKI MARU, about 300 mi south, had 45-kn winds and 16-ft seas.

The storm appeared as if it were headed for Alaska, but late on the 19th, it turned southeastward. Several ships reported 40-kn gales, but the HOYO MARU topped them all with 23-ft seas and 26-ft swells near 48°N, 164°W. The LOW was now filling and weakening, and on the 21st, it split into three centers.

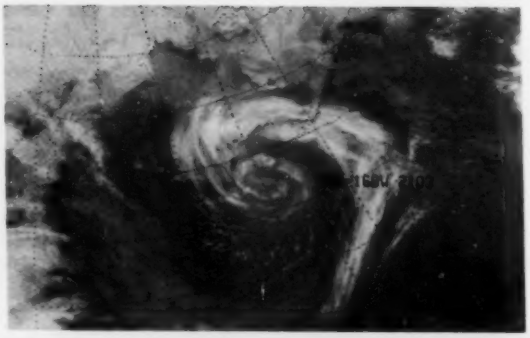


Figure 52.--At approximately 2100, the LOW was near 52°N, 170°W, and still deepening.

The NORSE VIKING (48°N, 152°W) found 40-kn gales with 26-ft waves on her starboard side. Later that day, the original LOW was absorbed by the southernmost of the three, which then moved northeastward.

This incipient storm formed on the 17th near Chejudo, Korea. In the next 24 hr it traveled the length of Honshu, and turned to parallel the Kuril Trench. It was not until 0000 on the 20th that it concerned other than small fishing vessels. At that time, it was 977 mb, near 53°N, 150°E, and the JUJO MARU (49°N, 160°E) was beaten by 50-kn winds with 13-ft seas and 39-ft swells. East of the center and the occlusion, the KANAGAWA MARU was blinded by heavy snow driven by 40-kn southeasterly winds with 23-ft waves.

The LOW was moving northward along the coast of Kamchatka on the 21st. Ostrov Beringa measured 70-kn winds. There were two reports of 50-kn measurements in the Kuril Islands and the southern part of the peninsula. The highest ship wind was 45 kn, but the UNION PROGRESS was more concerned with the 20-ft seas and 25-ft swells in the cold water north of the Rat Islands. At 1200, the KANAGAWA MARU no longer had heavy snow, but the winds were now 50 kn out of the west with 28-ft swells. The central pressure was now rapidly rising, and the system became history on the 22d.

Tropical Cyclones, Western Pacific--Tropical storm Lorna blossomed briefly among the Caroline Islands toward the end of the month. She was first detected as a depression, near Truk on the 27th. She headed northwestward and reached tropical storm strength the following day after crossing the 10th parallel. Lorna was never more than a minimal tropical storm. Early on the 29th, she turned toward the southwest. Later in the day she weakened. Lorna fizzled out south of Woleai on March 1.

Casualties--The 2,980-ton Japanese freighter HEKIYO MARU and the 2,374-ton Somalian vessel KUN SHAN collided in fog about 126 km east of Hong Kong on the 17th. Five of the 21 crewmen aboard the HEKIYO were rescued by the KUN SHAN. High winds near Dubai, in the Persian Gulf, resulted in the oil rig WODOCO breaking loose and colliding with the drilling platform W.D. KENT. One man drowned and 5 were seriously injured.

ROUGH LOG, MARCH 1976--The number of cyclones traversing the North Pacific was far above normal. The track chart north of 35°N over the western two-thirds of the ocean was a mass of lines. The lower limit of the tracks gradually migrated northward to the latitude of Seattle from approximately 160°W eastward. The major difference in the actual tracks from the climatological pattern was a more easterly than northeasterly orientation over the western half of the ocean. This resulted in tracks farther south than normal over the central ocean. A secondary track toward and over the Bering Strait was a primary track this month.

The Aleutian Low was split into two centers as is usual, but the deeper of the two (1005 mb) was over the Gulf of Alaska rather than south of the Rat Islands as is normal. The Pacific High had two centers, 1025 and 1026 mb, verses the usual 1022 mb. The 1026-mb center was near 35°N, 135°W, and the 1025-mb center was near 31°N, 174°W.

The most prominent anomaly centers were positive in association with the two high-pressure areas, 5 and 6 mb. The only significant negative anomaly was 5 mb over the Bering Sea.

The upper-air 700-mb pattern was very much like climatology with basically zonal flow over the water. A major trough was just east of Japan, and a minor trough was near 155°W. As with the surface, the primary anomaly centers were associated with the surface high-pressure centers and over the Bering Strait.

There were no tropical cyclones this month.

Extratropical Cyclones--During the first half of the month there were many cyclones over the North Pacific, but they were generally small and weak with no exceptionally high winds or seas. It was no oddity to find five or six centers over the water at one time.

At 0000 on the 10th, a wave developed on a cold front south of Shikoku, Japan. It traveled east-northeastward and deepened after crossing the Izu Trench. It was 982 mb, near 42°N, 164°E, at 0000 on the 12th. The KASUGAI MARU was north of the center, near 46°N, 160°E, with 35-kn easterlies and 21-ft seas. The LOW continued to move east-northeastward as its pressure decreased very slowly.

At 0000 on the 14th, the HOYO MARU (50°N, 177°W) was 360 mi west of the center with only 40-kn gales, but the seas were 10 ft and the swells 28 ft. At 1200, two more ships reported 40-kn gales, but the waves were in the 20-ft range. On the 15th, several small LOWs developed, and one of these became the primary circulation on the 16th.

About 36 hr after the previous LOW formed, another developed south of Kyushu. The center moved south of the Islands before turning northward on the 13th. At 0000 on the 14th, the 990-mb storm was near 43°N, 160°E. The SEPTA was whipped by 50-kn winds near 43°N, 166°E. At the same time, there were four reports of 40-kn gales in other quadrants of the storm. The highest waves were 18 ft.

As the LOW approached the Kamchatka Peninsula, Ostrov Beringa measured 50-kn winds. At 1200 on the 15th, the storm was curving eastward south of the Island which now measured 70-kn winds (fig. 53). The ZARETCHIE, at 52°N, 176°E, experienced 45-kn winds and 23-ft seas at the occlusion. The storm

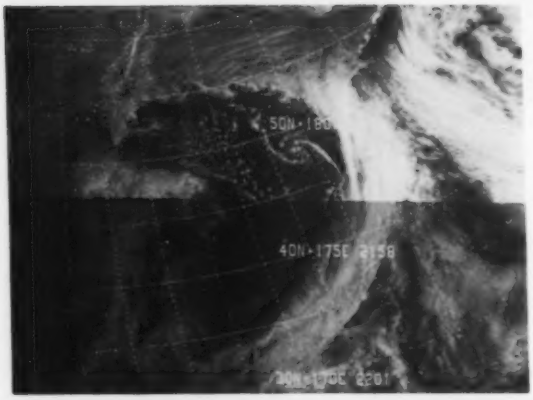


Figure 53.--At approximately 2154, this storm is barely discernible near 53°N, 163°E. Another storm is approaching from the south, and a new circulation is forming near 48°N, 178°E.

continued eastward and was absorbed by another circulation on the 16th.

As the previous storm moved northward, it left a trough that extended over the Sea of Japan. As the trough moved across Hokkaido, a 1002-mb LOW formed over Ostrov Iturup at 1200 on the 15th. This LOW quickly developed a large circulation as the original storm deteriorated. By 1200 on the 16th, it was 982 mb near 50°N, 156°E. The TOKO MARU, near 39°N, 154°E, reported 40-kn gales. At 0000 on the 17th, the PAN EASTERN (42°N, 159°E) had roaring 60-kn westerlies. Ostrov Simushir measured 50-kn northwesterlies. With those windspeeds, the wave heights reported were surprisingly low.

On the 18th, the 986-mb LOW was moving eastward. A fishing boat near Kiska Island found fishing rough in 40-kn gales. The NICHIHARU MARU was north of the Aleutians, at 0000 on the 19th, with 35-kn gales and 23-ft swells. South of the center, near 42°N, 174°E, the PAN EASTERN again encountered 60-kn winds. At 0000 on the 20th, a ship reported 60-kn winds near 44°N, 165°W, near a trough line.

On the 21st, this LOW and another combined with rapid deepening. At 0000, a ship with no call sign printed, near 47°N, 150°W, and about 100 mi south of the 978-mb center, reported 65-kn winds from the west, with 16-ft seas and 20-ft swells. The 969-mb LOW moved directly over Ocean Weather Station Papa about 0800. At 0000 on the 22d (fig. 54), Papa measured 50-kn winds with 26-ft seas, and the EIYO MARU (52°N, 153°W) had the same winds with 16-ft seas and 23-ft swells. Other ships farther south were having only 30-kn gales, but the swells were running 25 ft. By 1200, Papa's wind was only 40 kn, but the seas had increased to 30 ft.

On the 23d, the storm stalled, near 57°N, 145°W, to disappear on the 24th.

A frontal wave was analyzed, near 40°N, 177°W, at 1200 on the 23d, thanks to a report from the OREGON MAIL. The LOW moved northeastward and was 988

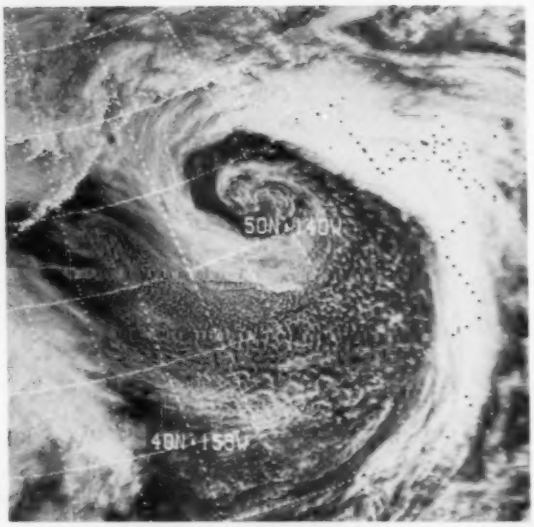


Figure 54.--Ocean Weather Station Papa is in the northwesterly flow with attending high seas at this time.

mb, near 50°N, 155°W, at 0000 on the 25th. At that time, a ship near the occlusion (46°N, 150°W) was plotted as reporting swell code 31 or 51 ft. Code 13 (21 ft) would be more reasonable compared with other reports.

At 0000 on the 26th, the 980-mb LOW was near 53°N, 140°W. A ship, at 54°N, 145°W, reported 65-kn winds in a heavy thunderstorm with hail. To the south, OWS Papa had 45-kn winds and 21-ft seas. Farther south, at 44°N, 140°W, the ROSE S. contended with 23-ft swells. On the 26th, the storm crossed the coast of Alaska into the Northwest Territories.

This LOW moved out of the Yellow Sea on the 26th. It moved across Japan, and at 1200 on the 27th, it was 992 mb near 39°N, 148°E. A ship reported 23-ft waves about 350 mi south of the center. On the 28th, there were 3 reports of 40-kn winds ranging from southwest to northwest of the center.

By 0000 on the 30th, the LOW was 974 mb near 51°N, 171°E. A ship at 44°N, 177°E, had 45-kn winds. Waves in the area were about 15 ft. Twelve hours later, the TAIKAI MARU (46°N, 172°E) found 25-ft swells. At 0000 on the 31st, a ship near 52°N, 166°W, was plotted with swell code 41 (67 ft). The ship's code could not be deciphered because of the 35-kn wind barb. The seas were listed as 13 ft. On the 31st, the storm was filling, and at 1200 the DATAN MARU (49°N, 177°W) was sailing into 45-kn winds and 20-ft seas. On April 1, the LOW was gone.

This storm formed on the 29th in the same vicinity as the previous one and closely followed the same track. After crossing Japan, it deepened to 985 mb near 43°N, 154°E. On the 31st, gale-force winds were blowing in all quadrants. At 1200 on the 1st, the 972-mb storm was near 54°N, 173°E. The BREWSTER, at 51°N, 167°E, was mauled by 100-kn winds from the northwest (fig. 55). The seas were listed as 20 ft. Three hundred miles to the south, the ASAISHI MARU was sailing with 45-kn winds and 23-ft swells.

At 0000 on the 2d, the DATAN MARU (48°N, 177°E) came in with 55-kn winds. The KORENGA (52°N, 177°E) had 50-kn winds and 16-ft seas.

On the 3d, the LOW moved into Bristol Bay. In the latitude band of 45° to 50°N, three ships had 40- and 45-kn winds with seas and swells of 26 to 30 ft. At 1200 on the 3d, a ship at 51.5°N, 156°W, reported 49-ft swells.

On the 4th, the LOW split as it crossed the Alaska Peninsula. One center moved toward the Bering Strait, and the other remained stationary near Kodiak Island.

Casualties--The 15,498-ton Indian JAG SHAKTI, from Seattle, was at Madras on the 25th, with heavy weather damage. The 2,958-ton Japanese SENYO MARU sank in stormy seas off Taiwan on the 19th. Eighteen of the 24 crewmen were rescued. All 30 crew members of the Korean freighter SHINYANG (1,599 tons) were rescued after a collision in poor visibility with the 14,000-ton Japanese freighter CHUKO MARU off the entrance to Yokohama port on the 31st.

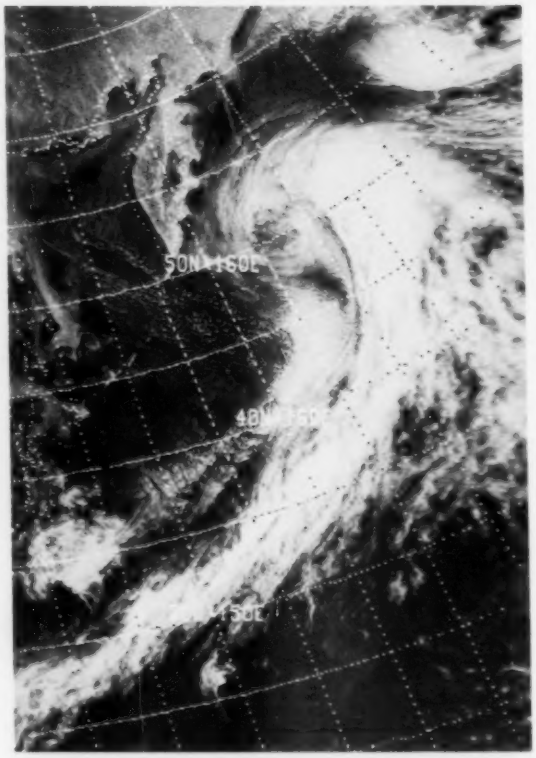


Figure 55.--This image was obtained at about 2300 on the 31st. The LOW was then near 51°N, 167°E, the position of the BREWSTER 13 hr later.

Marine Weather Diary

NORTH ATLANTIC, JUNE

WEATHER over the North Atlantic is usually very pleasant in June. The number of active extratropical LOWs continues to decline, and storms are usually confined to the higher latitudes--centers north of 45°N over the western ocean and 55°N over the eastern ocean. The building Azores High averages near 1024 mb for the month and is centered over midocean near 33°N, 38°W. The Icelandic Low, oriented east-west, is quite diffuse with the lowest average pressure about 1010 mb, just off the coast of Labrador, near 58°N.

WINDS are controlled largely by the Azores High, with the transient LOWs causing the daily variations. Between 25° and 55°N, southwesterly winds predominate, except over the eastern ocean from the Bay of Biscay southeastward, where northerly winds prevail. South of 25° to about 5°N, the "northeast trades" are generally steady. North of 55°N, winds are mostly variable. On the Mediterranean, east to southeast winds are common over the western half, while northwest winds blow steadily over the eastern portion. Northerly winds are predominant off the Iberian Peninsula and northwest coast of Africa. Northwesterly winds prevail over the eastern Gulf of Mexico, while southeasterly winds are predominant over the southern North Atlantic between the Equator and 5°N. Windspeeds over most of the North Atlantic during June are force 3 to 4. Lighter force 2 to 3 winds are most common over the Mediterranean Sea, Davis Strait, Gulf of Mexico, Bay of Biscay and waters southwestward, and near the Equator. A band of force 4 to 6 extends northeastward from the vicinity of Bermuda toward Ireland.

GALES over the North Atlantic are infrequent during June. Only in the waters near southern Greenland and over northern portions of the Norwegian Sea does the probability of encountering gales exceed 10 percent.

EXTRATROPICAL CYCLONES are fewer in June than in May and not as intense. Cyclogenesis throughout the summer occurs principally in the area from the Carolinas, west of 65°W, to Hamilton Inlet, Labrador, west of 50°W; north of Scotland; northwest of Iceland; over the waters southwest of the British Isles; and over the Gulfs of Finland, Riga, and Bothnia. The major storm tracks during June extend from the Newfoundland area northeastward to the waters south of Iceland, and then east-northeastward across the Scandinavian Peninsula. Another primary track extends from Iowa across central Lake Michigan to southern Lake Huron and down the St. Lawrence River, where it joins a track that develops off Cape Cod.

TROPICAL CYCLONES. Tropical storms average about one every 2 yr. The preferred area of tropical cyclone formation is over the western Caribbean and the Gulf of Mexico. The 45-yr period, 1931-75, had 25 tropical storms, of which 11 reached hurricane strength.

SEA HEIGHTS of 12 ft or more occur between 5 and 10 percent of the time over a broad area that includes the Labrador Sea, around the southern Greenland coast into Denmark Strait, then south of Iceland to the Faeroe Islands and southward to off Ireland's west coast, then southwestward to about 500 mi off Cape Race, and northwestward to include again the Labrador Sea. Other small areas are located between Norway and the Shetland Islands, off the central Norwegian coast, and in the Gulf of Lions. Frequencies of 10 percent or more occur only over an elliptical area immediately south of Kap Farvel. A flat oval area of swell greater than 12 ft over 10 percent of the time is centered about 55°N, from south of Kap Farvel to Ireland. The oval changes from about 5° to 10° of latitude thick from west to east. An area of over 20 percent occurs about 200 mi off the coast of Colombia.

VISIBILITY. The frequency of fog approaches its maximum over the northern ocean. The Grand Banks is the foggiest region--visibility below 2 mi is reported on more than 30 percent of all observations. The percentage of this low visibility decreases to between 20 and 30 percent of the observations over the Davis Strait and the northern Labrador Sea, and over the waters east of Kap Brewster, Greenland. The latter area is usually ice-covered at this time of year. The fog is generally observed in warm, moist air brought by southerly winds into this area of cold ocean temperatures.

NORTH PACIFIC, JUNE

WEATHER. The summer regime is well established over the North Pacific in June. Vigorous extratropical storms are increasingly less frequent. The Subtropical High is centered near 36°N, 149°W, and has an average central pressure of about 1022 mb. The Aleutian Low, located north of the western Aleutian Islands, fills rapidly during June; by the end of the month, it has disappeared, leaving only a trough.

WINDS north of the trade wind belt are variable over the broad scale, ranging from northwesterly to northerly off the United States and Canadian coasts, to southerly east of Japan, to westerly over the Aleutians. Over the Gulf of Alaska, they are southerly to westerly. Northeast of Hawaii, the winds blow from the northeast. The speeds average force 3 to 4 north of 25°N. South of 25°N (30° east of 145°W) to the Equator, steady "northeast trades" dominate, with force 4 the most common speed. The southwest monsoon is established over the South China Sea. Southeasterlies prevail over the Philippine Sea, switching to southerly south of Japan and Korea.

GALES are rare in June. Only over a small area near 46°N, 145°W, does the chance of encountering gales exceed 5 percent.

EXTRATROPICAL CYCLONES. The most favorable area for cyclogenesis continues to be east of Honshu.

The primary storm tracks lead from here east-northeastward to the Gulf of Alaska. Another track approaches the Gulf of Alaska on a northeasterly course from midocean.

TROPICAL CYCLONES. The probability of tropical storm development continues to rise sharply in June, approaching the late summer and early fall maximum. On the average, three of these storms develop per year--one or two during this month in Asiatic waters, and one or two over the ocean area between 10° and 20°N, and the Mexican west coast and 120°W. About two out of three western North Pacific tropical storms go on to become typhoons. One out of three eastern North Pacific storms reach hurricane intensity.

SEA HEIGHTS of 12 ft or more have a frequency greater than 10 percent only in two small areas. One is centered south of the Alaska Peninsula near 48°N, and the other south of the western Aleutians near 46°N. Generally, sea conditions are improving as summer approaches. Areas of high swell are located in the northern Gulf of Alaska and Bering Sea, south of the ice edge.

VISIBILITY. The frequency of low visibility increases over most of the North Pacific. The waters east of the northern Kuril Islands are particularly foggy, with the visibility dropping below 2 mi in over 40 percent of the observations. From the outer boundaries of this area northward to Kamchatka, southward to the central Kurils, westward to the eastern Sea of Okhotsk, and eastward to 162°E, this percentage drops to 30 to 40 percent of all observations. The area of low visibility, which encompasses 20 to 30 percent of all observations, extends from the southern Sea of Okhotsk through the central Kurils, and then eastward through the North Pacific along the 40th parallel to 165°W. The line bordering the boundary of the area then bends westward to midocean near 47°N, 175°E, before curving northeastward through the central Aleutians to St. Lawrence Island in the Bering Sea.

NORTH ATLANTIC, JULY

WEATHER conditions are relatively settled during July as the Azores High, centered near 35°N, 44°W, builds to a seasonal maximum of about 1025 mb, and primary storm tracks are displaced north of 45°N. The Icelandic Low remains an ill-defined east-west trough with the lowest pressure, about 1009 mb, centered near Hudson Strait in eastern Canada.

WINDS over the middle and northern latitudes have southerly and westerly components. Northerly winds are common near the entrance to the Mediterranean, while over the Sea itself, northwesterly winds are steady. Winds from the northerly quarter are found over the North Sea, off the central Norwegian coast, and over the Davis Strait and the waters southwest of Iceland. The "northeast trades" blow between 10° and 25°N, while in the Gulf of Mexico, easterly winds are most frequent. Near the Equator, southeasterlies dominate the area between South America and Africa. Windspeeds average about force 3 to 4 over most of these areas except over the Mediterranean Sea, the Davis Strait, and the Gulf of Mexico, where force 2 to 3 winds are prevalent. The strongest winds, of which nearly two-fifths of all observations are force 5, are encountered over the waters of the southwestern Caribbean Sea.

GALES. The frequency of gales is at a minimum for the year. Only over the Norwegian Sea is the percentage frequency of gales 10 percent or higher.

EXTRATROPICAL CYCLONES. From June to July, a marked northward shift of cyclonic activity occurs over the North Atlantic. Areas of cyclogenesis are along the North American coast from the Carolinas to north of Newfoundland, in the Denmark Strait, southwest and north of the British Isles, in the Adriatic Sea, and over the Gulfs of Bothnia, Finland, and Riga. The primary cyclone tracks lead from the Hudson Bay region northeastward through the Davis Strait, from the Grand Banks and the Gulf of St. Lawrence toward Iceland, and from north of Scotland eastward across southern Scandinavia. Two secondary tracks cross the Great Lakes. One extends from the Great Plains across eastern Lake Superior toward Labrador, while the other cuts an east-northeasterly swath across Lakes Erie and Ontario, New York, and New England, before merging with the Carolina storm track over the Gulf of St. Lawrence.

TROPICAL CYCLONE activity is still limited. On an average, three storms will occur during a 4-yr period, and half will develop into hurricanes. July tropical cyclones usually originate over the Gulf of Mexico or just east of the Lesser Antilles. Those forming over the Gulf generally move northward across the Gulf Coast, while those born east of the Lesser Antilles may move westward across the Caribbean Sea, or northwestward toward the southeast coast of the United States, where they often recurve to the northeast. Sometimes these storms are bred north and east of the Bahama Islands during July.

SEA HEIGHTS of 12 ft or more are encountered with a frequency of 10 percent or more only in a small area immediately south of southern Greenland.

VISIBILITY. Like June, July is one of the foggiest months of the year over the western North Atlantic. Observations with visibility less than 2 mi average 10 percent or more northward of a line drawn from the waters between Cape Cod and Cape Sable northeastward to near 60°N, 30°W. From there, the 10-percent frequency line runs eastward, south of Iceland, to near the Faeroe Islands, and then southward, cutting across Scotland near the Firth of Forth. The line then extends northward along the Prime Meridian to about 63°N, where it heads northeastward to the coast of Norway. The 20-percent frequency line is a little less erratic. It extends from near Cod Island, Labrador, eastward to near 56°N, 47°W; it then extends southwestward across Newfoundland to the Grand Banks. From there, visibilities less than 2 mi occur 20 percent or more of the time west of a line drawn to the coastal waters of Greenland, near Kap Mosting, and then north of the same line extended to 74°N, 20°E. Enclosed within the area defined by Godthaab (Green-

land), Resolution Island, and Ivigtut (Greenland), observations with visibility less than 2 mi exceed 30 percent.

NORTH PACIFIC, JULY

WEATHER. The steady and rather settled summer weather conditions that commenced in June over the North Pacific become widespread and firmly established during July. The Aleutian Low has disappeared from the pressure chart of normals, and the Subtropical High, with a pressure of 1026 mb, has moved northward to near 38°N, 150°W.

WINDS. Because of the strong development and northward position of the Subtropical High, the "northeast trades" extend over a large portion of the ocean. They prevail over all but Asiatic waters south of 30°N. Over the eastern ocean, they extend northward to about 35°N. The southwest monsoon is well established in Asiatic waters, blowing most steadily over the South China Sea. The westerlies of the middle latitudes, because of the absence of the Aleutian Low, are less steady than during the colder months. Large southerly components are found over the western two-thirds of the ocean at these latitudes, while northerly components are the rule closer to the conterminous United States and are also observed out from the Gulf of Tehuantepec. Easterly winds prevail over the waters of the Gulf of Alaska. Windspeeds over the Pacific average slightly less than force 4.

GALES associated with extratropical cyclones are rare during July over almost all of the North Pacific, but a frequency greater than 5 percent does exist over a 2° square north of the central Aleutians.

EXTRATROPICAL CYCLONES. Cyclogenesis during the summer occurs in Asiatic waters from Taiwan northward to Sakhalin, and northeastward to the Near Islands. The greatest frequency is east of Honshu and Hokkaido. Two other areas are found near 47°N, from 155° to 175°W, and over the Gulf of Alaska. The primary storm tracks lead from Honshu northeastward to the Bering Sea, and from a point near 52°N, 157°W, to the Gulf of Alaska.

TROPICAL CYCLONES. Usually three or four tropical storms occur over the western North Pacific during July. Only one of these will not become a typhoon. These storms originate mostly over the ocean areas east of the Philippines. During their early stages, they generally move west-northwestward; after development, some may continue across the northern Philippine Islands into the South China Sea, while others curve northwestward toward Taiwan, the coast of mainland China, Korea, or Japan. Those reaching higher latitudes generally recurve toward the northeast under the influence of the upper westerlies.

Another area of tropical cyclone activity is over the waters off the west coast of Mexico. Around four tropical storms can be expected in July, with one reaching hurricane force. These storms are usually shorter lived, but can be dangerous to both marine and coastal interests. They normally move west-northwestward out to sea, but sometimes they pass inland over Baja California.

SEA HEIGHTS of 12 ft or more may be expected about 10 percent of the time in two small areas south of the Aleutians, near 48°N, 165°E, and near 49°N, 155°W. Areas of high swells are located in the Gulf of Alaska and Sea of Okhotsk.

VISIBILITY. Compared to other months of the year, the occurrence of low visibility over northern waters is most frequent during July. The visibility drops below 2 mi in over 40 percent of all observations over a circular area bordering the northern Kurils on the west and centered near 48°N, 158°E. The 30-percent frequency line is less circular, running from southwestern Kamchatka across the central Kurils to a point near 43°N, 160°E, and then northeastward to the Rat Islands, before swinging westward to Mys Shipunskiy. The 20-percent frequency line also crosses the central Kurils, but extends farther up the west coast of Kamchatka. This line then continues southeastward from the Kurils reaching south of 40°N, between 160°E and the dateline, before moving east-northeastward to a point near 48°N, 145°W, and then north-northwestward to Afognak Island. The entire Bering Sea is enclosed within this 20-percent frequency line, with the exception of the waters northeast of St. Lawrence Island, and the waters north of a line drawn from Mys Ozernoy to Mys Navarin. The 10-percent frequency line is very similar to the 20-percent one. It stretches from the northern Sea of Okhotsk southward to the southern Kurils; it then continues southeastward to a point near 34°N, 170°E, before shooting east-northeastward to about 40°N, 140°W, and then north-northwestward to the Gulf of Alaska.

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